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THE Chemical Age

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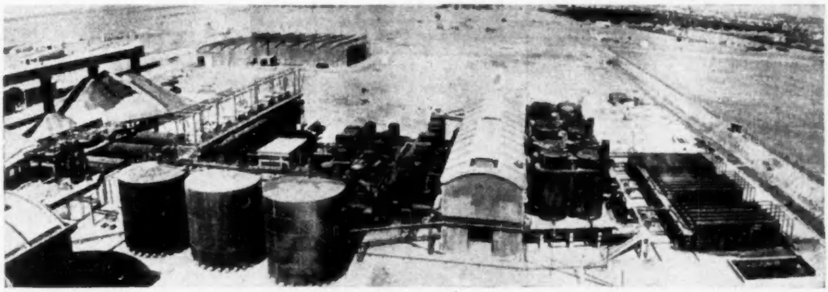
SULPHURIC ACID PLANTS



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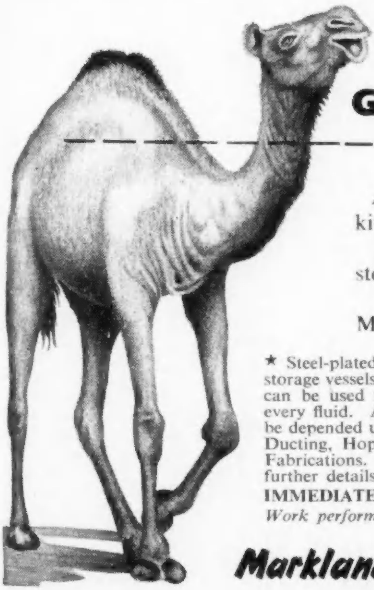

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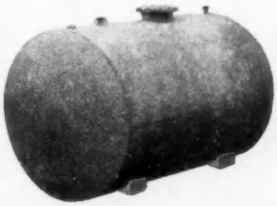

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DSIR Economics

IT was apparent a year ago (see THE CHEMICAL AGE, 1954, **70**, 715) that the Treasury's lamentable attitude of economy towards the DSIR—both petty and false when applied to a budget of £5,000,000 a year—had been put into reverse gear. Now, with the publication of the 1953/54 Report, it is possible to get something of a preview of the better-supported DSIR's intentions. It is certainly stimulating to find that the Department's reaction has been so swift. The estimated expenditure for 1954/55 is £6,267,210. This makes better reading than the early reaction expressed in last year's report which implied that the annual cost of the Department would be allowed to rise to 'rather more than £6,000,000' over the period 1954 to 1959.

Tight-fisted economists may feel disposed to question whether a five-years' programme of expansion should hit its annual target of costs in the first year. It is more sensible to recall the official reservations that accompanied the Government's offer of fuller support—'the financial provisions are, of course, subject to the necessary funds being voted annually by Parliament and must be subject, also, to review in the event of a marked change in the economic situation or to major changes in costs'. It would have been a grave disservice to the country if the DSIR had been slow and cautious in utilising its hard-won increase in housekeeping allowance. As every housewife knows, opportunities of this kind are best acted upon immediately and before the mood is altered by circumstances or indigestion. It is not as if the DSIR had to look hard or travel far in order to indulge in a spending orgy; their files were crammed with postponed projects and frustrated necessities.

However pleasing it may now be to see the DSIR apparently spending more money upon some of these needs of the present and neglects of the past, it is disconcerting to find that the jump in one year to 'rather more than £6,000,000' can be mainly attributed to two factors—increased staffing costs, and the provision of funds for the British contribution to the European Organisation for Nuclear Research. This latter item of expanded cost was not allowed for in the Government's late-1953 proposals for enlarged DSIR support. In 1953/54 it amounted only to some £43,000; its estimated cost for 1954/55 is £360,000. Thus there is already a new demand upon the DSIR equivalent in cost to approximately a third of the total extra annual support offered. The expectations of other DSIR services must be correspondingly reduced unless this new liability is met by an addition of at least £300,000 a year to the previously promised support for 1954/59. In any case the DSIR is already supporting nuclear research in universities, by means of grants for special work, to an annual cost of about £300,000. No one in his senses would quibble over that. Nevertheless, the fact remains that nuclear research is a new charge upon the nation, and where its costs are being met out of

funds designed to support older branches of research there is at least a case for arguing that something is wrong with the system of national book-keeping. What is still a far from generous national contribution to vital research of many kinds is being strained by the need to give priority to one entirely new subject, nuclear physics. It can only be hoped that the Government will recognise this somewhat anomalous position and supplement its support for DSIR accordingly.

The other factor that has so swiftly raised DSIR expenditure — increased salaries and wages and provision for additional staff—is certainly not open to criticism. Scientists in official service have never been over-paid and their economic status has been progressively worsened by the advances in costs of living. As recruitment is a pressing necessity—as many as 1,000 extra workers are estimated to be required during the 1954/59 expansion—there must be a reasonable inducement for scientists and technicians to enter the DSIR and, more important still, to stay in it. It appears from the report that staff numbers will be increased by 200 during 1954/55. As the costs of extra staff will not have to be met in all 200 cases with a full year's pay, and 200 is only a one-fifth instalment of the scheduled increase of 1,000 by 1959, it seems obvious that the DSIR staffing cost will, even by 1957, become impossible to absorb comfortably within the estimated annual over-all figure. The DSIR Advisory Council make it clear that this problem is one of considerable concern; they hope to present a revised programme of staff needs before the end of 1955. We can only hope that they will not flinch from firmly telling the Government that something substantially above £6,000,000 a year and not merely 'rather more' than that sum is inevitably required.

The hard truth is that new research needs and existing research costs are both steadily expanding and the pace is too great for moderate cost ceilings to be laid down in advance for a five-years' period. 'There is plenty of evidence in the report that not even the spending of another £1,000,000 per annum will enable the DSIR to meet all the demands that are made upon it.' That was our comment a year ago when assessing the 1952/53 report, and in just that period of 12 months the comment has become self-evident.

An important branch of DSIR activity is, of course, the Research Associations, partly financed by the DSIR and partly by the industries specifically concerned. The fact that 10 out of some 40 such organisations have had their finances reviewed during the year would seem fortuitous—nine were cases in which grant renewal came up for discussion during the year and the other case was a reconstruction following the relinquishment of temporary 'take-over' by the Ministry of Food. Broadly, what the DSIR has now proposed—with acceptance—is that industry should provide a greater share of the basic annual income, but at the same time the maximum contribution from the DSIR can be larger if the industry's extra support is expanded. To take one example, the former annual grant to the Shirley Institute was £50,000 provided that the cotton industry contributed £180,000, with an extra £100 for every extra £100 from the industry up to a maximum additional grant of £30,000. The new scheme provides a block grant of £50,000 provided that the industry contributes £220,000, with the extra £100 per £100 up to a maximum addition of £40,000. An industry's opportunity to derive the maximum proportion of help from the DSIR is in future even more definitely determined by the extent to which it raises extra funds above the limits set by the terms of block grant provision.

With well established research associations whose results have already shown themselves to be effective and profitable, this change seems well designed. It is to be hoped, however, that the older pattern of DSIR contribution to basic costs will be maintained for research associations that are still youthful and small, and particularly for any new associations that may be under consideration. British industry being a mixture of large and small businesses, the incentive for further research associations is more important, than the incentive for expansion until the collective effort has truly proved its merit.

Notes & Comments

Paid as they Earn?

RECENTLY the Ministry of Labour announced that for the first time in history the average earnings of an industrial worker in this country had reached £10 per week. Presumably this figure makes little recognition of special skills or responsibilities, the possession or exercising of which would add to the £10 average. A recent inquiry by *The Financial Times* sought to show the picture of scientists' pay, and the conclusion was reached that the average scientist with a first-class degree and years of research experience can reckon to be paid between £1,500 and £1,700 a year at 50, but that further increases before retirement will be unlikely or small. It was pointed out that this standard compared unfavourably with average earnings in a number of other professions including that of the business executive. Figures given last month by the Institution of Professional Civil Servants showed that the Scientific Officer Class, open to scientists with first-class or good second-class degrees, had a salary scale range of £492 10s. to £1,950; this range is sub-divided into scientific officers, senior scientific officers, principal scientific officers, and senior principal scientific officers, and the respective minima are £492 10s., £1,010, £1,185, and £1,700. Here, of course, direct comparison of somewhat similar responsibilities is possible, i.e. with the Civil Service's administrative officers, and it is estimated that in the course of a lifetime's career with the service the administrative officer can draw £14,000 more than a scientific officer. The administrative officer with a degree can rely upon £1,180 at the age of 30; a similar salary level is not reached by the scientific officer until he is 36.

A Weakening Influence

THESE figures suggest that scientists are making a notable contribution towards the egalitarian economic state, and as the country is not politically committed to that particular target it would seem a needless contribution. £1,700 as the 'average ceiling' is not a fitting reward for highly skilled work of great national importance; applying even the most moderate conversion factor for today's £ in terms of the pre-war £, this is equivalent to less than £750 or £800 in 1938/39. Scientists in industry can earn appreciably more, but almost invariably this involves leaving the laboratories and combining science with commerce. The extent to which this is occurring today is considerable and the point may well be reached when science is weakened by it. The explanation is obvious and human enough—science alone does not pay as it earns. It is true that there has been a steadily increasing recognition of scientists since 1939, in both respect and reward, but economically this seems merely to have kept pace with the rising costs of family life.

Dropping the Pilot

SIR CHRISTOPHER HINTON thinks that too many chemical engineers are spending too much of their time on pilot-scale work. He has said so quite often, and on Monday in a paper presented to the OEEC conference he pointed out once more that 'in the last eight years, during which time we have been building up the atomic energy industry in this country, the urgency with which production has been required has normally been so great that we have not had time for the construction of pilot plants'. There is much to be said for this point of view: most chemical engineering processes are surface effects, while a change of scale is a change of volume, and it is notoriously as difficult to go from pilot to full-scale as from laboratory quantities. After all, the primary separation plant at Windscale, as Sir Christopher remarked, was designed from the results of experiments carried out at Chalk River on only 20 mg. of plutonium. Nevertheless, we wish he had chosen some other example than Windscale. 'The plant,' he said, 'went into operation virtually without trouble.' No mention of the dust filter units on the stacks from the piles, which the designers completely forgot until nearly 400 feet of stack had

been built, so that they had to be inserted at the top instead of the bottom. That meant the construction of a lift to reach the filters, and all the consequent difficulties of extra radiation protection. No mention of the concrete screening for the piles, which somebody forgot to vibrate while it was being poured, so that it was as proof to neutrons as wire-netting to a pea-shooter. That had to be torn down and built again. Admittedly these are not the problems that commonly face the chemical engineer, but it is likely that a pilot stage would have revealed their existence, and saved much time, worry and money.

Indian Refinery Opened

THE largest oil refinery in India, built near Bombay by Burmah-Shell Refineries Ltd. at a cost of over £23,000,000, and completed a year ahead of schedule, was formally declared open on 17 March by Dr. S. Radhakrishnan, Vice-President of India.

Situated on Trombay Island, 10 miles to the north-east of Bombay, the refinery, which incorporates the most modern equipment, will process 2,000,000 tons of crude oil a year. Its production of petrol, kerosene, diesel oils and furnace oils will be the highest in India. In addition it will also produce the greater part of the country's bitumen requirements.

The initial planning and investigation work for the refinery began in 1952, and despite early difficulties the 450-acre site was acquired in 1953. Within 18 months a labour force, which at its peak numbered 14,000, converted the marshy land into a busy refinery. A well equipped laboratory to test refined products is now complete and is run almost entirely by Indian personnel.

To provide staff for higher technical positions, arrangements were made for 29 Indian trainees to visit the UK and Europe for nine months' to a year's training on site during the construction work.

Russians See Silicones

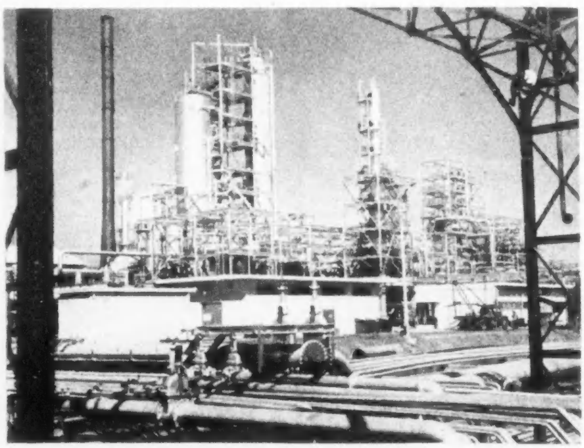
FEATURE of the Fourth Electrical Engineers' Exhibition, held at Earls Court from 15 to 19 March, was the stressing of the effectiveness of silicones in insulation. Both Midland Silicones Ltd. and I.C.I. (Nobel Division) had stands at this exhibition for the first time and reported a keen interest and a large number of inquiries—including one from a Soviet trade delegation, which visited both the stands.

Working models helped to put the message across. Midland Silicones, for example, showed a silicone insulated electric motor of ordinary construction running without any trouble while submerged in water.

Attendance at the exhibition was a record. By the third day, 17 March, the attendance figures had exceeded last year's total.

Chemical Society Library

The Chemical Society library will close at 1 p.m. on Thursday, 7 April, for the Easter holidays and will re-open at 10 a.m. on Wednesday, 13 April.



A view of part of the Burmah-Shell oil refinery near Bombay, opened on 17 March

More West German Expansion

Coal Chemicals, Polythene, Nitrogen, Potash Increases

PRODUCTION of coal derivatives in West Germany has shown some improvement in recent months after the stagnation due to reduced coke and gas requirements in 1954. Last year the production of coal-tar amounted to 1,607,000 (1953: 1,615,000) metric tons, of crude benzole to 435,000 (444,000) tons and of ammonium sulphate to 418,000 (450,000) tons. The demand for some coal chemicals on the other hand expanded, with the result that stocks of coal-tar pitch and naphthalene were depleted, crude benzole had to be imported in greatly increased quantities and heavy tar oils which could not be sold to the USA were easily absorbed by the home market. It is expected that disposal of the larger quantities of coal derivatives now becoming available will not cause any difficulties.

Quite a number of new coal chemicals have started operations in the past 12 months. The plant of Phenolchemie GmbH at Zweckel, started up last August, is operating at a rate of 8,000 tons a year. A new coumarone resin plant has added substantially to the output capacity of Rütgerswerke AG at Castrop-Rauxel. New toluene and xylene columns are being added to the benzene distillation plant of Redestillationsgemeinschaft at Gelsenkirchen. Chemische Werke Gergkamen AG now produces *n*-butyl alcohol and *n*-amyl alcohol as well as *n*-propyl alcohol. Krupp Kohlechemie GmbH resumed production of hard paraffin at the Fischer-Tropsch plant. Rheinpreussen AG has raised its propyl and butyl alcohol capacity to 10,000 tons a year and converted its detergents plant to dodecyl benzene.

Polythene Plant Commissioned

A large polythene plant is to be put into commission by the end of this year by Farbwerke Höchst AG, which has now raised its share capital by DM.99,300,000 to DM. 385,000,000. Having invested a total of DM.310,000,000 in 1952-1954, the company has made plans for capital expenditure totalling DM.175,000,000 in the current year. Höchst is also concerned in the erection of a polythene plant in the Ruhr area by a company in which Deutsche Erdöl AG and Mannesmann AG are also interested. As Badische Anilin- und Soda-Fabrik AG and Rheinische Olefinwerke GmbH are likewise pressing forward with polythene projects, West German production is certain to increase substantially in the next year or two.

Farbwerke Höchst AG also proposes to spend substantial sums on manufacturing facilities in the US, Brazil and the Argentine and on the extension of its marketing organisation. The recent visit to Höchst of Mr. C. E. Wilson, of W. R. Grace Co. of New York, was reportedly connected with a joint project for the formation of a producing company in Brazil; this joint plant is to produce electrolysis products, textile agents and solvents.

Nitrogen Fixation Plant

A new nitrogen fixation plant with an output capacity of 48,000 tons of primary nitrogen will be erected by Hüttenwerk Salzgitter AG at an estimated cost of DM.20,000,000. The company now operates coke-oven plant, and by-product installations for coal-tar, benzole, ammonium sulphate and sulphur in this locality, in which are also situated important blast furnace, steelworks, rolling mill and power installations.

The West German potash industry last year raised its output from 1,321,000 to 1,615,000 tons (K_2O) while sales advanced from 1,403,000 to 1,589,000 tons (K_2O). Stocks which were reduced slightly in 1953 were thus fully maintained in 1954, but this appears to be due entirely to delays in purchases by German farmers towards the end of the year. Leading potash producers report that foreign demands continue satisfactory. A further increase in exports which last year amounted to about 650,000 tons (K_2O) or over 40 per cent of total sales is generally anticipated. To provide the larger tonnages required, the potash works are to be mechanised further, experience with experiments in this direction having been very satisfactory.

Small quantities of German polyester fibre based on the Terylene patents, but marketed under the trade name of Diolen, are now made available by Farbwerke Höchst AG. Terylene has aroused considerable interest in the German textile industry.

Factory Equipment

Biggest Exhibition Next Week

THIS year's Factory Equipment Exhibition, from 28 March to 2 April, is to be held at Earls Court for the first time. The last two exhibitions have been at the Royal Horticultural Hall, but the demand for space has been so great that the site has had to be transferred. The area is nearly seven times larger than that of the first exhibition, in 1953.

The exhibition is devoted to the display of equipment dealing with mechanical handling, packaging, storage, the keeping of records and costing, safety and welfare of employees and the maintenance and planning of factories. It is to be opened by Sir Miles Thomas, D.F.C., chairman of BOAC.

Among the exhibits will be a new buffered barrier cream containing a light screen to control ultra-violet light, affording protection against photo-sensitising materials which produce skin conditions varying from mild erythema to exudating dermatitis and skin cancer.

A large range of protective clothing for use in industry will be shown by professional mannequins at a thrice-daily parade to be held during the exhibition. Among the items on display will be nylon overalls, a variety of shields and goggles and industrial gloves, boots and shoes.

A number of conferences will be held during the week. On 28 and 30 March there will be conferences on Work Study organised by the British Productivity Council. Among the speakers will be Mr. R. M. Currie, head of the Central Work Study department of I.C.I., and Mr. P. H. Saxon, head of the Work Study department of Burroughs Wellcome & Co. Sir Ewart Smith, deputy chairman of I.C.I., will be the conference chairman on the second day.

'Fuel Efficiency Pays' will be the theme of a conference on 29 March organised by the National Industrial Fuel Efficiency Service and Combustion Engineering Association.

New Weedkiller

THE first chlorate weedkiller to be completely free from fire risk is claimed by Borax Consolidated, Limited (Borax House, Carlisle Place, London, S.W.1). Known as Polybor Chlorate, the new non-selective weedkiller is a combination of borates and chlorate. The special manufacturing process, by which each individual particle of chlorate is combined with the borate to remove all danger of fire, is the subject of a British patent (No. 701,057).

Polybor Chlorate can be spread dry by hand or applied in water solution as a spray. It contains a wetting agent. It is officially approved by the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland, and will kill both the foliage and roots of weeds and grasses.

The main uses for Polybor Chlorate will be around outdoor structures and buildings of all kinds, on paths, timber-yards, parking areas, and railbeds. The absence of fire risk allows its use around petroleum refineries, in oil storage areas and chemical plants.

The first shipment of bulk liquid and dry chemicals from the US plants of the Dow Chemical Company to its new Dutch subsidiary, Nederlandsche Dow Maatschappij N.V., was recently completed via Dow's leased tanker, 'Marine Chemist.' Shown left, the vessel stands berthed at Waalhaven, Rotterdam harbour, after discharging its cargo. Among the products the firm will process are polystyrene, magnesium alloys, and glycols

MIDLANDS SOCIETY FOR ANALYTICAL CHEMISTRY

Aspects of Atmospheric Pollution

THE February meeting of the Midlands Society for Analytical Chemistry was held jointly with the Birmingham College of Technology Chemical Society in the College Chemistry Department. Mr. J. R. Leech, the society's chairman, introduced the speaker, Dr. G. H. Booth, of the DSIR Fuel Research Station, East Greenwich, saying that the subject of atmospheric pollution was of topical interest in view of recent Parliamentary and newspaper discussion.

Dr. Booth opened his lecture by saying that one of the earliest things one learns in chemistry is the composition of the atmosphere. Thus, oxygen and nitrogen between them account for about 99 per cent of the volume of dry air, while the remaining 1 per cent is made up of small amounts of other gases, such as carbon dioxide, the 'rare gases,' etc. This simple view of the composition of air is not very applicable to the majority of the industrial areas of this country, however. Here one also meets with appreciable quantities of oxides of sulphur and nitrogen, hydrocarbons and their oxidation products. These latter gases can be classified as pollutants.

In this lecture Dr. Booth said that he proposed to confine himself to the pollutants arising from the combustion of fuels, i.e., coal, coke, petrol, etc., in house and factory chimneys, diesel and motor car engines. This 'fuel pollution' can be conveniently divided into three phases:

(1) *Solid*: This consists largely of carbon and soot, which are small particles of unburnt coal and coke present in black smoke and arising especially from industrial chimneys.

(2) *Liquid Matter*: This consists largely of small droplets of tarry matter present in yellow and white smokes and arising especially from domestic chimneys.

(3) *Gaseous Phase*: The most important constituent is sulphur dioxide. Even the best coal contains 1-2 per cent sulphur, which cannot be eliminated prior to burning. Other constituents are hydrocarbons and carbon monoxide from motor car engines, and oxides of nitrogen from diesel engines.

Not only is smoke wasted fuel, but it has grave consequences on the public health, on vegetation, and on property. Particles of soot and tar greatly diminish the amount of sunlight, cutting off the health-giving UV rays. In addition they increase the number of fogs, which cause an increase in the use of electric light and hinder aviation. Clothes become soiled and stonework, wallpaper, and paint are blackened. The formation of sulphuric acid from sulphur dioxide and its corrosive effect on stonework are well known. Tar makes soot stick to surfaces and renders them difficult to clean. It blocks up the pores in the leaves of plants and prevents the absorption of carbon dioxide. It increases the number of people who suffer from respiratory diseases like catarrh and bronchitis. In the course of a day each person breathes six to seven times as much air by weight as the food and drink he consumes.

Increased Use of Coal

In the Middle Ages, wood was the only common fuel in use. Coal was burnt occasionally, but its regular use was frowned upon by the authorities on account of the smoke and dirt it caused. A Royal Proclamation of 1306 prohibited metal-workers from using coal in their furnaces, and one transgressor of the law was even hanged. The increasing difficulty in obtaining wood, however, led to a greater demand for coal, and by the middle of the seventeenth century its use became fairly general. Even in those days there were people who realised the unhealthy consequences of allowing smoke from coal fires to escape into the air. Since then the problem of atmospheric pollution has become much more serious.

The routine measurement of atmospheric pollution in this country is undertaken largely by local and various public authorities under the general guidance of the DSIR Fuel Research Station. In 1945 there were only 91 instruments being operated by 41 authorities. Today the numbers have increased to 1,500 instruments and 191 authorities. These instruments are in regular operation throughout the country and the results they provide give an indication of

the changes, for the better or for the worse, occurring in the extent of pollution principally arising from the combustion of various types of fuel. The results, amounting to some 130,000 per annum, are circulated monthly to the co-operating bodies.

Classes of Pollutants

For general purposes, pollutants are divided into three main classes:

(1) *Deposited Matter*: This refers to those particles of solid and liquid contaminant settling out from the air under their own weight, and includes solid particles of ash and unburnt fuel and liquid droplets of tarry matter of size range greater than about 20 μ. It includes a fraction of those smaller-sized particles and soluble gases, which are washed from the air by the action of rain.

(2) '*Smoke*': This refers to the suspended impurity in the air. By 'suspended impurity' it is usual to mean those liquid and solid particles of size range sufficiently small, usually less than about 20 μ, that they do not fall out of the air under gravity, but remain suspended until removed by impingement on surfaces, aggregation or washing out by rain.

(3) *Sulphur Dioxide*: This is sufficiently important to consider on its own.

An instrument which measures deposited matter will give an indication of general pollution from the combustion of fuel although the relative amounts of the various fractions collected will in general not correspond to the relative amounts emitted. The standard instrument in use is the subject of BS. 1747: 1951 and consists essentially of a resistant glass collecting-bowl of specified dimensions, discharging into a 10 l. bottle, also of resistant glass. The deposit gauge is normally exposed for one month at a time. At the end of the exposure period, the deposit in the bowl is washed down into the bottle, using for this purpose some of the rain water which will have collected in the bottle during the month. The bottle is then removed for analysis and is replaced by a new one.

The normal analytical procedure involves measurement firstly of the volume and pH of the water collected. The deposit is then divided by filtration into insoluble matter and filtrate. The insoluble matter is dried and weighed and then extracted with boiling carbon disulphide to determine the total tarry constituents. The residue is then ignited to give ash content and (by difference) combustible matter other than tars. From the soluble fraction, an aliquot is evaporated at 100° C to give total soluble matter and other aliquots are examined for calcium, chloride and sulphate ions by conventional methods.

In spite of some limitations, the deposit gauge is a most valuable instrument. The month to month variation of results is high, due partly to variation in emission of pollution in the neighbourhood, but far more due to variation in meteorological conditions. It follows that, for satisfactory conclusions to be drawn from the results of observations with this instrument, long term runs are most desirable. In practice, useful conclusions have been reached from 5-year groups of 60 observations, though significant changes have been detected within 12 months of their occurrence. It is usually considered that measurements with the gauge are representative of an area of about ¼ sq. mile round the instrument. A brief mention was made of an American development of the instrument, this being a ninefold deposit gauge.

Measurement of Impurity

The second standard instrument is for the measurement over a period of 24 hours of the total suspended impurity or 'smoke' in the air and of the sulphur dioxide content, expressed as a true concentration. The instrument is normally placed indoors and air from outside is drawn in to the apparatus through a sampling tube which projects from the side of the building in which the instrument is housed. This sampling tube is best located between 10 and 20 ft. above ground level and should project at least 3 ft. away from a wall.

The outer end of the tube is flared out into a small funnel which is orientated to point vertically downwards. The dimensions of the funnel are adjusted so that, when air is drawn in at the rate of about 50 cu. ft. per day, the velocity of entrance to the funnel is about 1 in. per sec. This prevents particles larger than about 20 μ, which fall faster than 1 in. per sec., from entering the funnel. By this means a rough and ready form of elutriation is accomplished.

The sampled air passes down the inlet, which should contain no sharp bends, where particles would tend to be deposited, and is drawn through a sheet of Whatman No. 1 filter paper held firmly between a pair of brass clamps and exposing a circular area

of radius 0.5, 1 or 2 inches to the gas stream. After passing through this paper, which serves as a filter for the suspended impurity, the gas stream passes through a Drechsel bottle containing dilute hydrogen peroxide (1 vol.) in which sulphur dioxide is trapped and oxidised to sulphuric acid. The gas stream is finally metered by a dry gas meter and the necessary suction is provided by an electrically-driven air suction pump. The actual measurements are then made as follows.

After sampling for 24 hours the filter paper is removed from the clamp and the 'smoke-stain' on it is compared visually in a strong diffuse light with a standard scale of shades, which has been calibrated against known weights of smoke drawn from the London area. From an assessment of the closest match (with interpolation where necessary) and the reading of the gas meter, the smoke concentration of the air is then expressed as mg. per cu. m.

Possible Errors

The method is liable to several errors. For example, the gradual increase in the resistance of the paper as its pores become blocked by particles results in a slowing down of the sampling rate. Thus the observed smoke concentration deviates slightly from the true daily mean and tends towards the concentration during the first few hours of the sampling period. When matching stains against the standard scale, the standard deviation has been found to be about 10 per cent provided that all the matching is done by the same observer. Different observers may persistently disagree by as much as 10 per cent. It is not easy, therefore, for the smoke concentrations in different towns to be accurately compared. The 'personal equation' can, of course, be eliminated by the use of photoelectric scanning of the smoke stain, but this is generally impracticable for routine work in view of the cost of the instrument. In addition some results quoted in 'Atmospheric Pollution in Leicester' (DSIR, 1945, HMSO) indicated that the smoke of central Leicester may be less 'black' than smoke in London, against which the scale of shades is calibrated. Strictly speaking, therefore, separate calibration is desirable for any specific area.

After assessing the smoke concentration, the sulphur dioxide concentration is determined by a direct titration of the dilute sulphuric acid collected in the peroxide bubbler. The dilute alkali used for the titration is N/250 borax and the end-point is taken, with a suitable indicator, at *p*H 4.5 to eliminate interference by carbon dioxide. A blank determination is done on an unexposed sample of the same hydrogen peroxide as that used in the Drechsel bottle. It can be shown, by having a second Drechsel bottle in series, that a single bottle is sufficient for complete absorption of the sulphur dioxide in the air. The concentration is generally expressed in parts per 100,000,000 by volume.

Sulphur Dioxide Determination

The third standard instrument is for the measurement of sulphur dioxide, giving a monthly average value. Lead peroxide is used as the absorbent and the instrument was developed in 1932 at the Building Research Station. The object was to provide a useful index of what may be called the 'activity' of sulphur dioxide in the atmosphere such as might have a direct application in estimating the relative effect of polluted atmospheres in attacking the fabric of buildings. A solid material was therefore sought which reacted with sulphur dioxide in a predictable and uniform manner.

The reaction of sulphur dioxide with lead peroxide proceeds at a convenient and uniform rate and both the reagent and the product (lead sulphate) are insoluble in water. This is a great advantage when the instrument is exposed in the open air. The instrument consists of a porcelain cylinder round which is tied a square of sulphur-free cotton-mesh fabric bearing a paste of lead peroxide and gum tragacanth mucilage, which has been allowed to dry slowly in a desiccator. The resulting 'candle' has a surface area of approximately 100 sq. cm. and is exposed to the atmosphere in a louvered box for one month.

At the end of the exposure period, the reactive material is cut from the cylinder, and after measuring its area accurately it is digested with a solution of sodium carbonate. The lead sulphate formed by the reaction between the lead peroxide and the sulphur dioxide in the atmosphere is converted to sodium sulphate. The solution is filtered and the sulphate estimated gravimetrically. The sulphur dioxide content of the atmosphere is then expressed in arbitrary units

of mg. SO_2 per 100 sq. cm. of lead peroxide surface per month. It will be observed that this unit is not a true concentration but can be taken as an indication of the corrosive action of the gas.

Other Factors Involved

There are a variety of factors other than the actual concentration of gas in the air which might be expected to affect the yield of lead sulphate by this technique. It has been shown in the laboratory that the reactivity of the lead peroxide is nearly independent of the rate at which gas is passed over the surface and in the open air the reactivity is not significantly dependent on wind speed. The effect of temperature is such as to increase the reactivity by 4 per cent for each 10° C rise in the temperature.

No significant correlation with relative humidity has been detected. The reactivity increases by from 10 to 90 per cent when the lead peroxide surface is wet. The provision of the louvred box is an attempt to minimise this effect by preventing the direct access of rain to the 'candle' when exposed out of doors.

It has been found that surfaces prepared from different batches of lead peroxide have appreciably different reactivities, probably because of differences in particle sizes and surface properties. To minimise errors from this source, it is usual to draw supplies from very large batches of material and to employ a correction factor to convert results to those which would have been obtained from a given standard batch of lead peroxide. By this means, results obtained over a protracted period and using a variety of different batches of material become directly comparable. It has been estimated that the total casual errors in practice correspond to a standard deviation of about 10 per cent.

The instruments so far described all give the mean values for the various types of pollution over a fairly lengthy period of time and as such are useful in building up a general picture of the pollution problem and for observing long term changes consequent on attempts to reduce emission. By such means a great deal of information is now available on what may be designated 'normal' pollution. There are special cases, however, about which very little is known and among these we have the instance of 'smog.'

Taking as an example the thick fog that covered London during part of December 1952, very little is known about the maximum concentrations of pollutants which occurred. The quantitative information available is that obtained from normal daily and monthly observations which were in routine operation at the time. Outstanding among these was a value of 1.34 ppm. of sulphur dioxide which was recorded as a mean value in Westminster on one day. There is no indication, however, whether this represented a uniform condition or whether there were shorter periods of much higher concentration.

In the investigations of 'smog' conditions, it is highly desirable to have available tests which can give values over short periods, preferably instantaneously. Furthermore, since the variation of pollution with time and place is likely to be an important aspect of the problem, it is also desirable that such tests should be of sufficient simplicity to enable them to be done by relatively unskilled operators, in order that an adequate number of tests may be made in the limited time that fog persists.

It was with these two points in mind that a special series of tests was developed at the Fuel Research Station to deal with the problem. On grounds of sensitivity, the colorimetric test was considered the most suitable. The procedure adopted is to aspirate a sample of the air to be tested through a circular piece of filter paper of small diameter bearing a spot of colour-sensitive reagent. A small hand-pump is used to draw the air through the paper. The volume of the pump being known, it is enough to count the number of pump-strokes required to bring about a predetermined change of colour of the test-paper and so to obtain an estimate of the concentration of a given pollutant.

'Smog' Tests Devised

By this means, tests have been devised to give measurements of smoke, sulphur dioxide and hydrogen sulphide and also an approximate estimation of the strong acid content of air. Full details of these tests and the reagents used have not yet been published. The equipment required to carry out these tests is light and readily portable, and can be operated with confidence by an unskilled operator after about two hours' training.

Another aspect of atmospheric pollution which has only recently been considered seriously is that arising from automobile ex-

hausts, with the emphasis on carbon monoxide. There are a host of methods available for the estimation of low concentrations of carbon monoxide, among which may be mentioned the volumetric or gravimetric determinations which involve the use of iodine pentoxide, and various physical methods such as infra-red absorption.

Although these methods are known to give reliable results they are not very suitable for measurements *in situ* in a busy street. The alternative method of collecting a large sample of gas and returning with it to the apparatus also has its disadvantages. The method which is being used therefore is a variation of the simple and portable aspirator and detector tube used in industry. The method depends on the measurement of the length of a stain produced in a tube containing potassium palladosulphide on silica gel when the reagent is reduced by carbon monoxide. The length of the stain produced by a known sample of gas aspirated through the tube at a specified rate is directly related to the concentration of carbon monoxide which may be read off from a calibration chart.

Up to the present, only a small number of measurements have been made at a few selected sites in the West End of London and concentrations of carbon monoxide varying from about 5 to 10 ppm. have been encountered. This applies to measurements in the open. Much higher figures have been obtained in confined spaces bearing motor traffic and values up to 500 ppm., i.e. figures well above the toxic limit for this gas, have been found. There still remains a large amount of work to be done in this field.

Other Toxic Gases

It should be remembered that carbon monoxide is only one of the toxic gases discharged from the petrol or diesel exhaust and the contamination of the air by unburnt hydrocarbons, their oxidation products and oxides of nitrogen remains to be investigated. With regard to oxides of nitrogen, nitric oxide and nitrogen dioxide will be trapped along with sulphur dioxide in the standard hydrogen peroxide bubbler to yield nitric acid. This will, of course, increase the titre required by the solution and give a spurious value for the sulphur dioxide measurement. It has not, in practice, been found to have a serious effect on the sulphur dioxide figure, however. After the normal titration with borax, the oxides of nitrogen may be determined quite readily as nitrate by colorimetric methods using phenol-disulphonic acid, although the technique is rather tedious and is not very suitable as a routine method for a large number of samples.

Sulphuric Acid Mist

Finally, Dr. Booth dealt briefly with the determination of sulphuric acid mist. It is known that some of the sulphur normally found in fuels is discharged into the atmosphere as sulphur trioxide although the relative proportions of sulphur trioxide and sulphur dioxide will vary widely, depending on the conditions under which the fuel is burnt. Furthermore, it is to be expected that some at least of the sulphur dioxide will undergo atmospheric oxidation to the trioxide, which combined with moisture will produce a mist of sulphuric acid. This mist will not normally be caught in the hydrogen peroxide bubbler, as the particles of low mobility are likely to pass through without coming into contact with a water surface.

It has been assumed for a long time that the total amount of sulphur trioxide in the air is small compared with the sulphur dioxide (about 1 per cent of the sulphur dioxide concentration). Recently, however, more attention has been focused on the trioxide, as it is believed to be far more active physiologically than the dioxide. Methods are therefore being sought for the specific determination of sulphur trioxide in the presence of the dioxide. Not the least of the difficulties experienced is that sulphur dioxide (probably in the form of sulphurous acid) is nearly always collected at the same time as the sample of sulphuric acid mist. It is extremely difficult to suppress the autoxidation of this sulphurous acid, with the result that determinations of sulphate will tend to be too high. Work is at present proceeding along several lines to overcome this trouble but it is not yet sufficiently advanced for one to say that the problem has been solved.

At this point the meeting was opened for questions to be put to the lecturer and for general discussion. When asked about possible application of the optical densitometer for measuring 'smoke-stains' on the filter papers employed in conjunction with the second of the standard instruments, Dr. Booth replied that they had one at the East

Greenwich Fuel Research Station, but that the instrument was too expensive for general use. He confirmed that the sulphur dioxide concentration as determined by the hydrogen peroxide bubbler, besides containing an error due to the presence of sulphur trioxide, also included errors due to the absorption of other strong acids from the atmosphere, e.g. oxides of nitrogen and hydrogen chloride. These latter errors, however, amounted to less than 1 per cent of the whole concentration, and could be neglected.

Several questions concerned the toxicity of various gases. It seemed that for sulphur dioxide the toxic limit was quite high, and certainly well above the smell limit, i.e. about 2 ppm. It was also quite high for carbon dioxide, but here the importance of the figure was really as an anti-oxygen limit in the air. In the case of hydrogen sulphide the toxic limit was similar to that for hydrogen sulphide poisoning, although chemists often spend whole days in an atmosphere with a high hydrogen sulphide content. Hydrogen sulphide may quickly render a person unconscious, and then the danger of poisoning is very real.

Inquiries were made about the measurement of the amount of smoke produced on burning different substances, and about the investigation of dusts inside buildings. There was also a lively discussion on instances of 'smog' and related phenomena in various parts of the world, and on the legal aspect of the prevention of atmospheric pollution.

Thanks are due to the Director of Fuel Research for permission to publish this report.

OCCA *Exhibition*

Speeds Application of Research

THE Seventh Technical Exhibition organised by the London Section of the Oil & Colour Chemists' Association, which was held last week at the Royal Horticultural Society's Old Hall, London, was at least as successful as previous exhibitions. The exhibition provided a technical display of the progress made during recent months in materials, equipment and technology. More important, it gave the young oil and colour chemist an opportunity to discuss technical problems with older and wiser heads.

At the luncheon which preceded the opening of the exhibition, Mr. R. F. G. Holness, B.Sc., A.R.I.C., chairman of the London Section of OCCA, said that the exhibition had a number of purposes, and a particular purpose was to get the developments in the producing industries known by the technical men of the consuming industries, so that those developments could be adopted at the earliest possible moment.

Finally, Mr. Holness thanked those who had abstained from showing at the exhibition (although they hoped to exhibit again next year) because they felt that this year they could not meet the standards that had been set. The Association owed a very sincere debt of thanks to such firms for having helped to maintain a high standard.

Sir Wavell Wakefield, MP, who replied on behalf of the guests and who later officially opened the exhibition, said that scientific progress was so rapid and extended over such a wide field that it was difficult for a man to keep in touch with it, even in his own particular sphere of activity. The exhibition gave the research worker, the scientist and the technologist a comprehensive picture of the progress that had been made during the past year in the fairly wide industrial field in which he was interested. It gave him the opportunity of assessing the direction in which progress was being made and the trends that were taking place.

It was in the direction of the quicker application of the results of research that Sir Wavell believed the OCCA exhibition had already made a useful contribution and would continue to be of even greater value in the future. It covered a wide and important field of industry. It was playing an important part in promoting industrial efficiency, without which we could not meet foreign competition.

In the laboratories of private firms as well as in those of our great national research institutions we were continuing to show fertility of invention and genius for discovery still unsurpassed in the world today. We had got to see that that supremacy was not lost by sluggishness or slothfulness in applying the results of research to quick production. If we did that, we need not become depressed when more youthful countries wished to start secondary industries, thus perhaps curtailing their import of products which we had previously exported to them.

Chemical Engineers in Europe

THE OEEC mission which visited the US to study 'Chemical Apparatus in USA' and produced in 1952 a report with that title thought fit to devote a considerable portion of the report to the need for more chemical engineers in Europe. The mission reported 'it is noteworthy that the old type of course in industrial chemistry is disappearing in the United States' and 'the old European tradition of relying entirely on the combination of the industrial chemist and the mechanical engineer now seems outmoded and has become a vested interest tending to stifle chemical engineerng progress in Europe.'

A further consequence of this report was the conference on 'The Functions & Education of the Chemical Engineer in Europe' which was held at Church House, Westminster, from 21 to 23 March. Organised by the Institution of Chemical Engineers in cooperation with DSIR for the European Productivity Agency of OEEC, the conference had for its object to draw attention to three main requirements in chemical engineering: the necessity for more chemical engineers and more schools of chemical engineering; the necessity for more financial aid for chemical engineering research; and the necessity for a more general recognition of the part that chemical engineering plays in modern industry.

Wide Representation

Nearly 350 attended, including delegates from Austria, Australia, Belgium, Denmark, Eire, France, Germany, Greece, Italy, Netherlands, Norway, South Africa, Sweden, Switzerland, Britain and the US. The European Federation of Chemical Engineering was represented by Dr. Bretschneider and Jean Gerard, and the OEEC European Productivity Agency by M. R. Gregoire, the deputy director, and MM. V. Lazareff and J. Pognan, of the applied science division.

The conference was divided into six sessions, each with its own subject, and some five or six papers on the particular subject were presented in each session. Because of limitations of time, the papers were not read, but each author in turn gave an outline of his argument.

The conference was officially opened by the Lord President of the Council, the Most Hon. the Marquess of Salisbury, K.G. He said that he was particularly happy to be present, for two reasons: because of his personal and official interests in higher technological education, and because of the international nature of the conference. In this connection he said he welcomed the schemes for the international exchange of students, and he concluded by wishing the conference every success.

Introductory remarks were made by M. Gregoire who, after mentioning the important place held by the chemical engineer today, said that this must be among the workers, and the engineer should be the link between those of most and least specialisation. The first session, presided over by Sir Harold Hartley, then began.

The subject of the session gave the title to the first paper, *The Part Played by the Chemical Engineer in Bridging the Gap between Research and Plant Construction,* but the author, **Sir Christopher Hinton,** said that this was the one title he would certainly not have chosen. To his mind, no hard and fast line could be drawn between the various types of scientists, 'chemical engineers' and engineers involved in the design of a process plant, who merge into one another like bands of a spectrum.

Engineering is an art, but with firm foundations in the physical sciences. Arts can only be learnt by practice, and so the true art of engineering can only be learnt by taking part in engineering work. What the Universities and technical schools should do is teach the scientific principles on which the art is based and show how these can be applied.

Considering the spectrum in more detail, it is made up of bands such as pure chemist, applied chemist, flowsheet designer, layout engineer, designer and detailing engineer. Those in the middle of the spectrum comprise the chemical engineers, but a more precise definition cannot be made, and all should overlap through mutual understanding. The construction and operation of pilot plants tends to be overdone. If design work is put in hand without the construction of pilot plant, the designer really has to think for himself, and it usually happens that by taking this risk better results are achieved.

There is the additional advantage that both time and money are saved.

In his comments, Sir Christopher said that he thought the best training for the chemical engineer was an Honours degree in chemistry or engineering, followed by post-graduate work in chemical engineering. In this way the basic sciences were first taught, and the student then learnt the application of these sciences to technology. He was not so happy about first degrees in chemical engineering, since he felt that the student tended to fall between the three stools of applied chemistry, applied physics and applied mathematics.

The second paper was *The Process Engineer in the German Consumer-Goods Industry*, presented by **Prof.-Dr. Kurt Riess,** a director and technical manager of Farbenfabriken Bayer AG, Leverkusen.

In the consumer-goods industry there are numerous tasks which presuppose special physical understanding, such as the treatment of ores, coal, stones and earth, foodstuffs, etc. These tasks are, in Germany, allotted to the 'process engineer,' who in comparison with the classical mechanical engineer has had a more complete training in unit operations.

In processes in which, in addition to the physical changes, chemical reactions play a considerable role, the process engineer works in alliance with the chemist. This team work has the advantage that the training of the process engineer, as well as that of the chemist, need not be less thorough, so that both can bring to bear the full basic knowledge of their separate specialities.

Dr. Riess said that he thought this system gave more freedom to the process engineer to devote time to his own interests. He referred to courses at Berkeley University, where there were chemical engineers in the chemical faculty and process engineers in the engineering faculty.

Dr. Luigi Morandi, of the Montecatini company, presented a paper on *The Function of the Chemical Engineer as a Link between Pure Research and its Industrial Application.* He said that the first two papers had shown the eternal conflict between theory and practice, and agreed that the functions of chemical engineering depended upon the administration and economy of the country. He stressed the need for the engineer to understand 'harsh economic realities,' since he effected the first economic control on the results of research. Imagination in the field of chemistry must be encouraged, and research should be free of all ties. The duty of the chemical engineer is to intervene at and after the pilot plant stage, planning full-scale plant, budgeting for expenditure, calculating depreciation and working out the cost of the final product.

Considerations of Technical Staff Requirements in the Evolution of an Industrial Chemical Project was the title of the paper by **Dr. R. Holroyd,** research director of I.C.I. This discussed the various stages in the evolution of an industrial project from the original conception to the design of the full-scale plant.

The closest collaboration between technical staff of varying training and experience is essential, not only at certain stages but throughout the course of the evolution process. The value of providing a substantial proportion of industrial technical staff with experience in more than one field, for example, by giving a research chemist experience in plant operation, has been proved, as has the need for all staff to acquire an attitude of mind which enables them to identify themselves with the ultimate objective of economic production of some worthwhile product.

In the chemical industry there is great scope for the chemical engineer and the fact that courses of instruction vary considerably in character might well be more of an advantage than a disadvantage. A chemical engineer must recognise that his academic training is only a beginning and that the type of work which he will most enjoy and in which he will be most effective will only become apparent after he has acquired some actual industrial experience.

Dr. Holroyd said that his paper approached the matter by the back-door, describing what was needed for the project and then deducing the kind of engineer required. He particularly wanted to emphasise the wide scope of interests necessary, and the need to work alongside scientists of other descriptions. He disliked the concept of the chemical engineer as bridging a gap, and felt it would lead to wasteful research, non-critical acceptance of research data by the process worker, and difficulties in design. All members of a chemical engineering team should be capable of two distinct types of job.

To a chemist a high yield and high rate were sufficient recommendations for a pro-

cess, but in production other factors were involved. Economic vetting should be done before design and development; the engineer should be able to estimate costs, and help with suggestions for research. In this way he could minimise pilot-scale work.

In a paper on *The Chemical Engineer in the Man-made Fibre Industry*, **Mr. C. F. Kearton**, director of Courtaulds Ltd., gave an account of the setting-up and organisation of a chemical engineering section in Courtaulds.

As a chemical engineer, the company had in mind a man who could break down into its component parts a manufacturing process in which matter is transformed or chemically changed, provide a specification for each sub-division, and recombine the whole into a scheme or flowsheet which represented an economical, workable and maintainable plant. The chemical engineer's preoccupation with design information distinguishes him from the chemist; his preoccupation with processes divides him from the mechanical engineer.

The work of the section is illustrated in Mr. Kearton's paper by five specific case histories: development of a new chemical fibre; improvements in the method of manufacturing CS_2; studies in the efficiency of sulphuric acid use; the building of a new factory in Alabama; and the production of acetic anhydride.

Mr. Kearton said that the chemical engineering outlook was best exemplified in the question 'Why this way?' The chemical engineer was not just a kind of chemist or a kind of engineer. Power of leadership and management was the hallmark of the mature man; his training should be such that above all else he could appreciate other sciences and techniques.

Opening the discussion, **Dr. Pohland,** representing the Federal German Ministry for Economics, introduced **Dr. Scott,** who said that the papers presented had shown a remarkable uniformity of opinion on the duties of the chemical engineer, although considerable diversity on nomenclature and training. He was concerned with the weakness of the technical-commercial link, and thought that a development engineer should be able to handle problems at all levels from the plant floor to the boardroom. While sympathising with Sir Christopher Hinton's antipathy to pilot plant, he felt sure that, had he been dealing with business men, he would not have got what he wanted without a pilot-scale demonstration.

Dr. C. L. W. Berglin of Australia proposed to 'bowl a Chinaman to Sir Christopher.' He suggested that there might be a region of resonance capture in the spectrum where a lot of energy could be lost.

Dr. R. J. Morley, of the British Coking Industry Association, put three questions, two to Dr. Holroyd and one to Sir Christopher. He asked: If pilot-scale work is to be kept to a minimum, how can market evaluation be carried out without a sufficient quantity of product? would there be any advantage in constructing a pilot plant parallel with a full-scale plant? and had Sir Christopher really had much regard for cost or efficiency in the plants he had built?

Dr. R. Lessing pointed out that Sir Christopher had omitted the vital attribute 'imagination.' Going directly from 20mg. of plutonium to full-scale had certainly required this most important of faculties. Training schemes should be planned to stimulate the imagination.

Disagreement with Sir Christopher's ideas on training were expressed by **Professor D. M. Newitt,** of Imperial College, who was in favour of degree courses in chemical engineering. Finally **Dr. A. Parker**, director of the Fuel Research Laboratory, said he felt that the spectrum should include experts in mathematics, statistics, market research, even a flair for deciding what labour could or could not do.

Replying to his critics, **Sir Christopher** first answered Dr. Berglin. He said that energy loss through resonance capture would occur if one always used the same spectrum; it must be composed of the right bands for investigation of the appropriate problem. To Dr. Morley he replied that one must deal with time as if it were money. He accepted Dr. Lessing's reproach, and informed Professor Newitt that an engineer was a physicist whose education had been completed.

Dr. Holroyd said that he had not meant to imply that all semitechnical work could at present be avoided, but he felt it admitted a lack of fundamental technical knowledge. **Mr. Kearton** said that the need to convince the 'businessman' was no longer so great; the necessity was being recognised for a scientist on the board of a company, and the chemical engineer should be recognised as a catalyst to advancement in industry.

Summing up the morning's session, **Sir**

Harold Hartley said it had revealed certain differences of opinion, and the discussion had contrived to impinge on the subjects of all five succeeding sessions. He had found Mr. Kearton's paper most heartening, the opening of the Alabama plant was a great and courageous experiment.

AT the afternoon session on *The Chemical Engineer in Plant Operation & Management* the chairman was Prof.-Dr. K. Riess. The first paper, with this title, was that of **Mr. J. A. Oriel,** of Shell Petroleum Co. Ltd. He described the attractiveness of life as an operating engineer, which he compared to being the captain of a ship.

There is a need for careful attention to maintenance and improvement of existing equipment, avoiding deflection of energy from this to the building of new equipment. The materials and equipment once provided, responsibility rests with the operating staff, and the paper considered some studies in management, the need for allowing staff to develop in its own way, and the responsibilities and disciplines that this enforces on management itself.

These three aspects, interest in the job, the importance of maintenance, and the duties of management, said Mr. Oriel, were what he particularly wanted to emphasise. The last was something in which the chemical engineer could really score: he brought the scientific approach, and what was 'operational research' but the scientific attitude to management? Management was not the control of the many by the few, but a pyramid of leadership, and the delegation of authority from top to bottom needed mutual confidence.

The paper presented by **M. N. G. Chorine,** director of development and research at Société des Produits Chimiques Coignet, Belgium, was entitled *The Role of the Chemical Engineer in the Operation & Management of Chemical Plants,* but it was principally concerned with suggestions how to overcome the critical shortage of chemical engineers in Belgian industry.

Many engineers specialising in other branches are employed in Belgian chemical industries, more particularly in their operation and management. Because these are not chemical engineers it must not be thought, however, that they operate the plants unsuccessfully. But because they are not prepared to approach the relatively complicated or mysterious formulations of chemistry, many Belgian engineers are reluctant to take a job in the industry.

The obvious general solution is to prepare more and better trained chemical engineers. The Federation des Industries Chimiques is particularly active in considering the problem, and many industries are becoming more aware of it, together with the teaching specialists in universities. A possible immediate solution would be the elementary teaching of unit operations, and the present programmes of Belgian engineering schools could absorb this without any major changes.

In the absence of **Prof.-Dr. Karl Winnacker,** of Farbwerke Hoechst, his paper on *The Chemical Engineer in Works Management & Administration* was read by **Dr. L. Kughler,** of Frankfurt University.

To judge from the experience of German industry, it is not worth while to train technicians who are half chemists and half engineers. The complex problems of the chemical industry make it necessary to have not only chemists with a thorough and extensive knowledge of all chemical subjects, but also engineers who have been specially trained in technical processes in addition to a good basic training. Works management in a chemical undertaking lies mainly in the hands of the chemist, supported and helped by the works engineer.

Successful management of the works will only be possible if the chemist and engineer collaborate closely in a spirit of mutual understanding. What they have to recognise is the interaction of natural scientific phenomena in the problems to be tackled and to classify them according to their significance. If this is done properly, one is bound to see what special duties fall to the chemist and to the engineer in the daily routine. So that they will be able to speak the same language, it is of vital importance that they both have a basic training in which physical chemistry occupies its proper place.

Similar considerations apply to the administration of an undertaking. It is part of the administration's duty to make a distinction between the important and the less important so as to distribute its forces in the proper proportions. Misjudgment or failure on the part of the engineer can be the ruin of a firm, no matter how excellent its chemists may be; similarly, if a basic

chemical reaction is misjudged or mistaken, the best technological processes evolved by the engineer may collapse. The balance of forces can be all the better maintained if the value and significance of those doing different work is realised, and if the problems are rightly judged. In this matter, the human factor is vitally important, quite apart from material considerations.

Final paper of the afternoon's session was by **M. E. Bognar,** head of the chemical engineering section of Cie. St.-Gobain, France, on *Chemical Engineering—The Turn-table of Technical Development in Plant Operation.*

Whether it is a case of setting up a works to operate a new process, or an extension or partial modification, the goal to be attained in modern enterprise is always dependent on the outcome of collaboration between individuals. The research worker and the economist are generally far removed from the actual works; the manufacturing staff, the technical department and the construction staff are on the spot but, their task being well-defined, they see things in a different perspective. The chemical engineer listens to all of them and his study takes account of the interests of each, which he endeavours to express in a language understood by all.

M. Bognar said the chemical engineer must be a co-ordinating centre, a psychologist, a diplomat, an interpreter—but he could not replace the pilot plant.

Opening the discussion, **Professor J. Cathala,** director of the Institute of Chemical Engineering, Toulouse, praised the independence and courage of M. Chorine in admitting the shortcomings of Belgian chemical engineering.

The next speaker said he welcomed the presence at the conference of four delegates from the TUC, two of whom had recently returned from the ILO meeting at Geneva. He considered that any time spent in the training of chemical operatives was of great value. Management was getting things done by successful organisation of other people, and he thought the chemical engineer could make his greatest contribution in management.

Prof.-Dr. Riess, to stimulate the discussion, made a number of remarks. He suggested that there was a great need for chemical engineers in chemical plant manufacturing firms. He pointed out that a very good place to begin factory training for an engineer was in the drawing-office. With regard to the chemist-engineer team, he said that a great advantage of the relationship was that one spurred on the other.

Mr. S. A. Gregory thought that the German opposition to the omniscient chemical engineer had now become tradition, and that the problem was one of overcoming this tradition. He pointed out that the 'process engineer' was one of the team of chemical engineers.

Professor M. Letort, of Nancy, said that every chemical reaction required a container, but this was in fact auxiliary, and less important than the reaction itself. He therefore considered that the chemical engineer should remain faithful to chemistry, leaving the mechanical side of the business to the constructional engineer.

Professor Kiesskalt, of Aachen, said he thought that the differences of opinion which had arisen were due solely to linguistic differences, and that the actual difference of fact did not exist.

Professor G. G. Lamb, representing the American Institute of Chemical Engineering, said that in America the first consideration in the training of the chemical engineer was an emphasis on principles. The descriptive side could safely be left to the engineer's own reading and experience, but it was endeavoured to give him authority as soon as possible. He asked whether the process engineer in Germany knew enough chemistry. He felt that the business of teaching in Europe should have the sponsorship of OEEC.

The disagreements in definition were referred to also by **Professor M. B. Donald,** of University College, London, who said he understood the German collaboration between a chemist and an engineer—but what kind of engineer could this be but a chemical engineer? He suggested a team of three: a chemist, a mechanical engineer, and a chemical engineer—the last making all the decisions and running the business.

Professor A. H. Nissan, of Leeds University, said the chemical engineer was composed of three elements: the chemist, the engineer, and himself as a person, who brought about a combination of these two to give an entirely different product. The sum total of the chemical engineer was not just that of his parts. As an example of the

value of the engineer to industry, he quoted a case where the solution of one problem had brought about a saving equal to the total expenditure on research.

Finally, **Professor F. Morton,** of Birmingham University, said he would have liked Mr. Oriel, in his excellent description of the delights of being a chemical engineer, to have stressed the thrill of responsibility.

Prof.-Dr. Riess said he found it very difficult to sum up, because of the linguistic differences. He pointed out that the German delegates had done no more than report what actually happened in Germany. 'One quality of a spectrum is its versatility' he said. 'Don't leave us out of it.'

THE third session, on Tuesday morning, was concerned with the presentation of model courses of study for a primary degree in chemical engineering. It started with a paper with the long title *To What Extent can the Traditional Training of the Chemist be brought into accordance with the Demands of the Recent Developments in Chemical Industry?* by **Prof. Dr. K. Schoenemann** of the Institut für Chemische Technologie der Technischen Hochschule Darmstadt, Darmstadt, Germany.

The paper (summarised) said that the tremendous advance of chemical industry in the last few years and its further development depend in a decisive measure on catalytic and continuous processes. Their optimum planning is determined at least as much by unit operations and apparatus construction as by chemical and technological considerations, especially those connected with reaction kinetics, which the chemist naturally comprehends in general more easily than the engineer.

Thus, in addition to the training of engineers in unit operations the training of chemical technologists must be promoted. A certain amount of technological knowledge which would be to some extent beneficial can be incorporated as a subsidiary subject in the generally established training of the chemist. More extensive and thorough training, which would be necessary only for a limited number of chemists, requires, however, a curriculum widely differing from that used for the training of chemists to date.

A paper, *The Planning of Courses* by **Professor T. R. C. Fox,** Shell Professor of Chemical Engineering, Cambridge, discussed some of the broad principles which should guide the planning of courses in technology.

University courses should be planned on a clear understanding of their primary aims —the development of powers of critical analysis and synthesis, the development of an ability to make 'unbiased' observations, the fostering of independence, initiative and judgment, and not least important, the development of an ability to compromise.

The time of the student should be devoted mainly to the 'core' subjects of chemical engineering, those designed to expound the basic scientific principles, those concerned mainly with the applications of these principles to design and those intended to foster an experimental outlook.

The third paper, *Instruction and Research in the Training of Chemical Engineers in Germany,* was by **Prof. Dr.-Ing. Emil Kirschbaum,** Director of the Institut für Apparatebau und Verfahrenstecknik of the Technische Hochschule, Karlsruhe, Germany. It said that in Germany the chemical engineer is not in some half-way position between an engineer and a chemist but is quite definitely an engineer. Consequently, his basic training during the first two years at college is the same as that of a mechanical engineer. Students are taught the principles of chemistry during this period.

In the later stages of the course the chemical engineer spends far less time on the theory of design of prime movers than does the mechanical engineer. The time thus made available is devoted to the design of process equipment, chemical technology, organic chemistry and physical chemistry, as this constitutes the best foundation for good relations with the chemist.

Some Notes on the Chemical Engineering Education at Delft were given by **Prof. Dr. Ir. P. M. Heertjes** of The Netherlands.

Commenting on them, Prof. Heertjes said that it was strongly felt that only fundamentals should be taught at a University. Every student at Delft had to do some practical work in industry in which he could see for himself some of the more detailed work.

One of the best methods to teach a man independent thinking was to let him do research, and at Delft a great deal of research was included, particularly in later years.

It was strongly felt that the education at University level should be individual education, and the programme should not be overcrowded.

In a paper on *Chemistry in Chemical En-*

gineering Education, **Prof. K. G. K. Peters**, Director of the Institute of Chemical Engineering and Fuel Technology and of the Institute for Testing Fuels, Heating Installations and Gas Technique, Austria, said that experience in many industries, completed and verified by observations at the Technical University of Vienna, show that the most important things in the training of chemical engineers are their education to logical reasoning and conveying to them a deep understanding for the basic subjects of mathematics, physics and chemistry. One should also aim at relieving the existing curriculum of such matter which only burdens the memory of the students with innumerable details which at any time can be found in handbooks.

A paper on *The Role of Numerical Calculations in the Teaching of Chemical Engineering* came from **J. Givaudon,** Consulting Engineer with the Union of Chemical Industries, France. The paper said that numerical calculations, although they cannot take the place of practical solutions for arriving at concrete and correct results are, nevertheless, excellent for penetrating the gist of theoretical formulae and fixing the conditions of application of them. It must not be thought that the calculations are, by themselves, sufficient to provide the solution to all problems. Their use reduces the number of experiments, but will not enable, in all cases, experimentation to be dispensed with.

During the discussion which followed, **Mr. F. I. Hurley,** of the United Kingdom Atomic Energy Authority, pointed out that the term 'chemical engineering' covered a very wide range of work.

The question is: 'Should the education for the people who are going to work in these different ranges be the same?' he asked. For example, should the education of a development engineer be the same as that of an operations engineer?

He then divided education into two parts —fundamental and applied training. There seemed to be some general agreement that fundamental training should be the same in the different parts of the range. Should it be the same on the applied side? He thought that in his own field, that of development engineering, there was room for people of different backgrounds.

Mr. Hurley also made the point that communication either orally or in writing was one of the most important functions of the chemical engineer, whatever his job. 'The great majority of technologists who are turned out from Universities are very weak in the field of communication,' he said, and he asked if it were not possible to improve the writing standards of graduates.

Prof. D. M. Newitt stressed the role of the teacher of chemical engineering. He must, he said, have some industrial background, keep in close touch with industry and understand its trends.

Every teacher would agree, he went on, that the time a student came to life was when he was given an original problem to solve—a piece of research. Before being given such a problem he should be free of the obsession of examinations.

Professor Fox took up Mr. Hurley's point about the education of the chemical engineer in the different ranges.

He said he would like to see in this country a 'staff college' with people coming back to it after some years in industry.

On the question of communication, he pointed out that few people were good at expressing themselves unless they knew very clearly what they were going to say.

The chairman, **Dr. J. C. Vlugter** (Netherlands), summing up, said it was very difficult to indicate what was a model course. It varied from university to university and from country to country. Germany and Britain, for example, had different ideas.

All the speakers agreed that chemical engineering science at a University should be taught in a fundamental way. He thought that here and there a little too much emphasis had been laid on unit operations, which were only part of the whole.

The importance of training the student to think independently had been stressed. How the chemical engineer got on later in life depended very much on his personality and temperament and that was something that could not be educated at the University.

(To be concluded in the issue of 2 April)

I.C.I. Silicone Plant to Start Soon

The silicone plant of I.C.I. (Nobel Division) at Ardeer is expected to be in production within the next few weeks. It will produce the whole range of silicones at present being imported from the General Electric Company of America with the exception of a few types which are General Electric specialities. Silicone fluids, silicone resins and silicone rubbers will be manufactured.

BPF Comes of Age

Annual Report Reviews Progress

MOST notable achievement of the British Plastics Federation, according to the annual report for 1954, has been the expansion of its technical work to keep pace with the rapid growth of the industry during the past ten years. The report reviews 21 years' history of the Federation. In 1943 there were only two technical committees. Today there are 33 active technical committees and sub-committees and 17 BSI plastics committees. Membership now stands at 294, 10 higher than a year ago.

Activities mentioned in the report include: the completion of a case in the Science Museum, South Kensington, illustrating the processing of plastics; the compilation of a new edition of the Buyers' Guide, and a code of practice for annealing polystyrene, both shortly to be published; the Surface Coating Resin Index, just published; and work on the drafting and revision of numerous British Standard specifications. The sale of abstracts reached a record figure in 1954.

Addressing the annual general meeting in London on 16 March, the retiring president, Mr. C. F. Merriam, said: 'I am rapidly approaching the 50th anniversary of my start in the industry, and when I look back to my early days in 1905 and compare them with the present day I can appreciate, perhaps more than most of you, the almost incredible developments that have taken place in plastics. I think it is right and proper for tribute to be paid to the work of the British Plastics Federation during the past 21 years in bringing manufacturers together and to their activities in improving the standards of performance. We can, I think, rightly feel that the Federation has grown up and is well and truly founded.'

Geneva Laboratory Opens

DR. Clyde Williams, president and director of the Battelle Institute, welcomed the 300 guests at the formal opening recently of the Institute's Geneva laboratory. Among the speakers were M. Denis de Rougemont, director of the European Cultural Centre, Professor G. Colonnetti, president of the Italian National Research Council, and Professor L. Jacque, Professor of Chemistry at the Ecole Polytechnique in Paris.

The newly opened laboratory building is situated on a 22-acre plot in Carouge, a suburb of Geneva. The three storeys and basement have a total area of 40,000 square feet and include a pilot plant laboratory. The main building is supplemented by a villa, which houses the administrative offices and library, and a second building which contains shops. The staff of 85 is carrying on research in the fields of physics, chemistry and metallurgy.

Canadian Hydrocarbons

FURTHER details of financial arrangements under which a $20,000,000 chemical industry will be established in Winnipeg to specialise in production of nitrogen-type fertilisers for the Prairie Provinces agricultural area have been given by an official of Winnipeg & Central Gas Company. The newly incorporated firm, Canadian Hydrocarbons, Limited, will be the chief participant. (See THE CHEMICAL AGE, 1955, **72**, 582.)

The firm will be based at Winnipeg and will develop a network of subsidiaries in fields allied to the petroleum industry. It has a $3,500,000 share authorised capital up to a limit of $25,000,000. Present shareholders in Winnipeg & Central Gas Co. will be given options on the new stock, and the gas company will retain a 20 per cent interest.

The industry will be based chiefly on the natural gas piped eastward from Alberta. It is understood that Arthur O. Little Inc., Cambridge, Mass., leading US industrial research firm, has conducted surveys for the location of a chemical industry in Winnipeg.

When financial arrangements are completed, Hydrocarbons will own Home Gas Co., Manitoba Propane, Regas and Saskatoon Propane and a controlling interest in Canadian Propanes. These will be transferred to Canadian Hydrocarbons by Winnipeg & Central Gas, present owner. Winnipeg & Central plans a pipeline to carry wet gas to Winnipeg from Tioga field in North Dakota, and this project, too, will now be taken over by the new firm.

Oil Found in Israel

Oil-bearing porous strata have been found on the shores of the Dead Sea, near Massada, Israel.

HOME

New QVF London Offices

QVF Ltd., who market 'Visible Flow' glass pipeline and 'Quickfit' industrial plant in glass, have opened new London offices at 81 Cromwell Road, S.W.7 (Telephone: FREemantle 4811). These replace the former premises at 13 Charterhouse Street, E.C. London representative of QVF Ltd. is Mr. G. D. Smith.

RIC Summer Visits

The London Section of the Royal Institute of Chemistry announces that 20 visits have been arranged during the summer for Fellows, Associates and Registered Students. The visits will take place between 4 May and 6 July, and the destinations include *The Times* newspaper offices and the BBC television studios as well as firms in the chemical and other industries and research associations.

UK Potash : Question in Commons

Mr. P. Wells (Kent, Faversham) asked the President of the Board of Trade in the House of Commons on 15 March whether he would consult with the interests concerned with a view to ensuring that the large potash deposits in North Yorkshire were not abandoned. In a written reply, Mr. H. Strauss, Parliamentary Secretary to the Board, said: 'The interests mainly concerned with the commercial development of these deposits are already in touch with my Department.'

New Unit for Cambridge Instrument Co.

Cambridge Instrument Co. Ltd. have decided to concentrate at their new factory at North Finchley a completely self-contained unit to deal with their increasing business in mercury-in-steel indicating and recording thermometers, vapour pressure dial thermometers, automatic temperature regulators employing these systems and pressure and vacuum dial gauges and recorders. As from 1 April inquiries about these instruments should be directed to Cambridge Instrument Co. Ltd., Mechanical Thermometer Division, Friern Park, London N.12 (Tel.: HILlside 5016).

Killed by Cylinder Explosion

When an oxygen cylinder exploded in a loading bay at the British Oxygen Co.'s Greenwich depot on 16 March, a lorry driver was killed, another man injured, and five others taken to hospital with shock. A month ago four men were injured when an acetylene cylinder exploded in the same bay.

New Engineering School for Billingham

More than £100,000 is to be spent by I.C.I. on a new engineering school at its plant at Billingham, Co. Durham. The new school, which should be in use next June, will enable the factory's apprentice training scheme to be extended. The front of the building will be over 350 ft. long, and the school will be much bigger than the present one which has been in use since 1946.

Institute of Physics Conference

Preliminary details of the summer conference of the Electron Microscopy Group of the Institute of Physics have now been issued. It will be held in the Chemistry Department, University of Glasgow, from 5 to 7 July. Hostel accommodation has been booked for 120 people and a registration fee of 10s. will be required by 31 March from those who wish to stay in the hostels. Notice of intended contributions will be required by the end of April. Publication of the full details, held up by printing delays, etc., is expected in the near future.

Shortage of Technologists, Says I.C.I. Chairman

Opening the Plymouth and Devonport Technical College on 17 March, Dr. Alexander Fleck, I.C.I. chairman, said industry wanted three types of leaders on its production side: scientists, technologists and technicians. Britain's greatest shortage, he said, was of technologists. Dr. Fleck said there was a shortage of scientifically trained people who could be called on to meet the needs of modern industry. This shortage was not merely one of quantity; there was also a shortage of trained scientists and technologists of the right quality.

· OVERSEAS ·

Increased World Oil Output

World output of oil and natural gasoline rose by about 28,000,000 tons to over 700,000,000 during 1954, according to the UN Monthly Bulletin of Statistics.

Yugoslavia & Bulgaria Sign Trade Pact

According to a one-year trade agreement recently signed between Yugoslavia and Bulgaria, Yugoslavia will export caustic soda, pyrites, lighting oil, sulphite cellulose and tannin to Bulgaria, and will import from Bulgaria some fertilisers, technical oils, and manganese ore.

US Carbon Black Output

Total carbon black output in the USA during January amounted to 134,388,000 lb., compared with 130,721,000 lb. in the previous month. Production of furnace blacks increased by 6 per cent, but that of contact black was down by 7 per cent.

Indian Penicillin Factory to Expand

Plans for expansion of the penicillin factory at Pimpri, near Poona, under the second Fve-Year Plan, and the question of bringing its production to modern standards, were discussed when the five-man Central Government committee to guide the factory met the managing director of the factory, Col. I. R. Dogra, in Poona recently. The committee inspected the plant in its minor details, and expressed satisfaction at progress achieved so far.

Aluminium Smelter Expansion Plans

The productive capacity of the Kitimat aluminium smelter in British Columbia is to be expanded to 330,000 tons a year—more than double the capacity now in operation or under construction. The cost is expected to be about $190,000,000 and most of the money will probably be met from the resources of the company, Aluminium Limited. Also included in the total sum is the cost of some further expansion of alumina facilities in Jamaica, which will be in addition to those announced earlier this month (The Chemical Age, 1955, **72**, 643).

Oil Search in Sicily

The Standard Oil Company of New Jersey has announced that it is to take part in prospecting for oil in Sicily.

Subsidy for Sicilian Sulphur Mines

The Italian Government has promised a subsidy for the Sicilian sulphur industry, and Sicily's Regional Assembly has approved a bill to grant loans to the mine owners to pay back wages. As a result, the owners decided not to close down the mines on 20 March as planned (The Chemical Age, 1955, **72**, 648).

Alberta Mill Site Altered

The St. Regis Paper Co. of New York has altered its proposed location for a $30,000,000 pulp mill in Alberta. The firm had announced plans to build the plant three miles from Edson, 100 miles west of Edmonton. But Alberta Industries Minister Willmore said the company now plans to build 40 miles farther west, near the swift-flowing Athabaska River.

Newsprint in Australia

During the year 1954, Australian Newsprint Mills Ltd., at Boyer, Tasmania, which had an 80 per cent increase in profits for the year ended October 1954, changed its chemical pulp component from sulphite pulp of Canadian origin, to a sulphate pulp supplied by New Zealand Forests Ltd. from their new mill at Kinleith, in the North Island of New Zealand. This pulp is manufactured from Radiata pine, and has proved very satisfactory for bleaching with the eucalypt mechanical pulp made at Boyer.

Canadian Heavy Water Output Too Small

Canada produces about six tons of heavy water a year at a cost of between $720,000 and $1,200,000 a ton. This output is considered much too small for future needs. Dr. H. K. Rae, of the Chemical Engineering section of Atomic Energy of Canada Ltd. made the announcement at the annual meeting of the chemical engineering division of the Chemical Institute of Canada in a speech on the problems of heavy water production. He said efforts must be made to expand production and reduce costs to prepare for the day when large quantities of heavy water will be required for electricity-producing atomic power plants.

· PERSONAL ·

DR. W. J. JENKINS, B.Sc., Ph.D., chairman of the Nobel Division of I.C.I. since 1951, is to retire at the end of March after a lifetime in the service of the company. Dr. Jenkins has given notable service to the Scottish Council (Development and Industry) as a member of the executive and chairman's policy committee of the Council. He has been a leading exponent of the value of consultation between management and staff.

At the annual general meeting of the British Disinfectant Manufacturers' Association on 17 March the following officers were elected: *chairman*, SIR KNOWLES EDGE, Bart. (William Edge & Sons Ltd.); *vice-chairman*, MR. W. MITCHELL (Hull Chemical Works Ltd.) ; *honorary treasurer*, MR. VICTOR G. GIBBS (William Pearson Ltd.). Executive Committee; MR. H. C. ASKEW (Reckitt & Colman Ltd.), MR. R. G. BERCHEM (Jeyes' Sanitary Compounds Co. Ltd.), MR. A. J. BLACK (Lehn & Fink Products Ltd.), MR. W. A. C. HALL (Prince Regent Tar Co. Ltd.), MR. H. IBBETSON (A. Ibbetson & Co. Ltd.), MR. J. J. MCAULAY (Cooper, McDougall & Robertson Ltd.). *Hon. auditors*, MR. A. GALE (Milton Antiseptic Ltd.), MR. F. C. SEAGER (William Pearson Ltd.).

Diplomas of Fellowship of the Institute were conferred at the yearly meeting of the City and Guilds of London Institute on 22 March. Among the recipients were SIR RALPH REED, A.C.G.I., former chairman of Albert E. Reed & Co. Ltd. and DR. ERNEST HARRY RODD, D.I.C., D.Sc., F.R.I.C., A.C.G.I., formerly with I.C.I. Dr. Rodd worked with the former British Dyestuffs Corporation. His work alone and in collaboration led to the advancement of theoretical knowledge and industrial practice in this field and many patents, papers and other publications stand to his credit. For many years he was liaison officer between the Dyestuffs Division of I.C.I. and the universities. Since his retirement Dr. Rodd has been editing the new and enlarged edition to 'Chemistry of Carbon Compounds' of which three volumes have now appeared. He is a member of the Council of the Chemical Society and a vice-president of the Royal Institute of Chemistry. Fellowships of the Institute (F.C.G.I.) are conferred on past students of the City and Guilds College in recognition of the contribution they have made to the advancement of the industry in which they are engaged.

Elected to an official fellowship in chemistry at Wadham College, Oxford, is MR. R. J. P. WILLIAMS, M.A., D.Phil., A.R.I.C., junior research fellow of Merton College.

MR. L. P. WENZELL has been transferred from the Development Department of Celanese Corporation of America to the new position of manager of special industrial developments in the market development department of the textile division of the company. Before joining Celanese in 1953, Mr. Wenzell had been with the US Bureau of Mines, Kolker Chemical Works and Monsanto Chemical Company.

Among the 25 eminent persons elected Fellows of the Royal Society on 17 March were PROFESSOR A. H. COTTRELL, B.Sc., Ph.D., Professor of Physical Metallurgy in the University of Birmingham; PROFESSOR K. C. DUNHAM, B.Sc. (Dunelm), S.D. (Harvard), D.Sc. h.c. (Dunelm), F.G.S., Professor of Geology in the University of Durham; ALEXANDER FLECK, D.Sc., LL.D., F.R.I.C., chairman of I.C.I.; PROFESSOR D. H. HEY, B.Sc., M.Sc., Ph.D., D.Sc., F.R.I.C., Daniell Professor of Chemistry, King's College, London; J. W. LINNETT, M.A., D.Phil., lecturer and demonstrator in chemistry in the University of Oxford; and F. C. TOMPKINS, D.Sc., Ph.D., reader in physical chemistry, Imperial College, London.

At a meeting of the Council of the British Plastics Federation on 16 March MR. W. CHARLES WAGHORNE, F.P.I., was elected president. The following officers were re-elected: *chairman*, MR. A. E. SKAN; *vice-chairman*, MR. C. C. LAST, F.P.I.; *hon. treasurer*, MR. H. W. GRAESSER-THOMAS, F.P.I. Group chairmen re-elected earlier were: MAJ. J. TREVOR-JONES, A.S.C.C., F.I.D. (Engineers Group); MR. R. W. LOWE (Raw Materials Suppliers Group); MR. W. M. C. NORIE (Laminated and Fibrous Products Group). New group chairmen elected were: MR. J. HARVEY (Plastics

Materials Manufacturers Group); MR. S. T. ELLICE CLARK (Moulders Group); MR. C. L. MALCOMSON (Fabricating Group).

Guest of honour at the Textile Institute's Spring Convocation on 18 March was MR. ROBIN DARWIN, C.B.E., Principal of the Royal College of Art, who spoke on 'The Interdependence of Art and Science.' At the convocation MR. J. R. WHINFIELD, C.B.E., M.A., F.R.I.C., received the Institute's highest award, that of Honorary Fellowship, for his work on Terylene. The cover of the diploma presented to him was bound in Terylene. The Institute Medal was awarded to MR. W. CROSSLEY and DR. P. W. CUNLIFFE, B.Sc., Ph.D., F.R.I.C., F.T.I., and the Institute Service Medal to MR. E. J. D. POOLE, F.R.S.A., F.T.I., MR. L. MORRIS, B.Sc. Tech., and MR. J. R. S. GOODALL, F.T.I.

Additional directors appointed to the board of Bowmans Chemicals Ltd. are MR. JOHN A. E. HOWARD and MR. GEORGE C. H. CLARK. MR. DEREK MATHER has been appointed secretary.

On 15 March MR. E. R. BLANE, F.Inst.P., A.R.I.C., associate technologist at Vacuum Oil Company's Central Laboratories at Wandsworth, retired after over 20 years' service. He is, however, remaining with the company for a limited period as a full-time consultant. Mr. Blane joined the company in 1934 as a salesman-chemist in the tanners' department. In 1938 he moved to the technical department and eight years later was appointed technologist in the field service of the department. In 1953 he was transferred to the company's central laboratories. During his service with Vacuum Oil Company Mr. Blane has been responsible for much original work on process products, particularly on wax emulsions, tanners products, and cutting and rolling oils. When Mr. Blane came to the company, he already had wide experience as an industrial chemist. He spent 1913-14 in the United States in control of the manufacture of sulphonated oils for the leather trade for a Boston firm. After two years in England for war service, he worked for the British Dyestuff Corporation, Manchester, until 1921, when he became works manager for James Malcolm & Co. (Glasgow) Ltd., of Runcorn, Cheshire.

Three new Fellows have been elected by the Textile Institute. DR. NORMAN HENRY CHAMBERLAIN, B.Sc., Ph.D., of Leeds, is Senior Lecturer in Rayon Technology at Leeds University, where he graduated in chemistry in 1927 and secured his Ph.D. in 1929. Dr. Chamberlain has supervised various commercial research projects and has lectured at Institute conferences and meetings. Much of his work has been published in the *Journal of the Textile Institute* and in other learned periodicals. MR. REGINALD MEREDITH, M.Sc., F.Inst.P., of Cheadle, Cheshire, graduated in physics at Manchester University in 1938 and until 1952 was with the British Cotton Industry Research Association. He has since been a Senior Lecturer at Manchester University. He has published close on 20 papers in the *Journal of the Textile Institute* and has contributed to four issues of the 'Annual Review of Textile Progress.' Mr. Meredith was awarded the Institute's Warner Medal in 1954 for outstanding work in textile science and technology. DR. EDWARD RACE, M.Sc., Ph.D., F.S.D.C., of Blackburn, is research manager and a director of Scapa Dryers Ltd., Blackburn. Dr. Race graduated in chemistry at Durham University in 1932 and secured his Ph.D. for work on the organic chemistry of iodine. Subsequently he secured his M.Sc. at Leeds University for a thesis on 'Studies in the Microbiology of Protein Fibres.' In 1949 he joined Scapa Dryers Ltd. His many papers in the *Journal of the Textile Institute* and the Journal of the Society of Dyers and Colourists have attracted wide interest. At present chairman of the Institute's Chemical Testing Committee, Dr. Race is a member of the Rotproofing of Textiles Committee of the British Standards Institution. He is a Fellow and Silver Medallist of the Society of Dyers and Colourists. Eleven new Associates have also been elected.

MR. W. W. WOOD, A.M.Inst.C.E., M.I.E.E., has retired from the position of general manager of Pirelli-General Cable Works Ltd., which he has held since 1940. He remains a director of the company. Mr. Wood is succeeded as general manager by MR. J. R. HARDING, B.Sc. (Eng.), M.I.E.E., former assistant general manager.

MR. L. KEARTON PARKER has joined Winston Electronics Ltd., Hampton Hill, Middlesex, as chief sales engineer.

Publications & Announcements

FIRMASIL glass is a low expansion borosilicate glass which is unaffected by acids (except hydrofluoric acid) and for all practical purposes by alkalis. It will withstand rapid heating and cooling without breaking, it can easily be 'lampworked' and does not devitrify under normal laboratory conditions. It is mechanically robust. These and other properties are described in an illustrated booklet prepared by the makers, Wood Brothers Glass Co. Ltd. of Barnsley. Distributors are A. Gallenkamp & Co. Ltd., Technico House, 17-29 Sun Street, Finsbury Square, London, E.C.2.

* * *

THE Equipment Division of Mullard Limited announce three valve voltmeters of unusually good performance. Two of these are general purpose laboratory instruments capable of measuring both direct and alternating voltages with a high degree of accuracy. The third, which measures only alternating voltages, incorporates a wide band amplifier to provide high sensitivity. All three voltmeters are mains-operated. These instruments differ only in the range of voltages which they can measure. The E7555/3 covers the range 100 mV to 500 V DC or peak AC, while the E7555/2 has additional ranges up to 15,000 V. The high sensitivity voltmeter E7556 measures alternating voltages between 0.5 mV and 300 V in the frequency range 20 c/s to 1 Mc/s with a total error of less than 4 per cent.

* * *

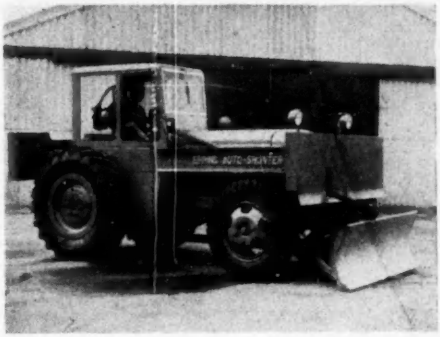
THE British Jeffrey-Diamond Rock Buster has been designed to meet operators' requirements for equipment which can reduce large rock to a product having a graduation of size acceptable to most markets. It can reduce any hard friable material from a maximum feed of 36 in. down to 90 per cent minus 1½ in. in one stage. Easy adjustment makes possible a wide variation in the size of the product. Available in two sizes, the Rock Buster is manufactured by British Jeffrey-Diamond Ltd., Stennard Works, Wakefield, Yorks.

* * *

FOR the first time a comprehensive index of British surface coating resins has been compiled for distribution to the industries concerned. The booklet, prepared jointly by the Surface Coating Resin Section of the British Plastics Federation and the Surface Coating Synthetic Resin Manufacturers' Association, gives in 14 tables the basic information on all the British-made surface coating resins at present available to the paint, printing ink and allied trades. So far as their complex chemical nature will permit, the resins—733 in all—have been classified according to type and within each of the 14 classifications they have been listed in alphabetical order by trade name. There is a list of all the producers contributing and, for easy reference, indexes both to producers and to trade names. The 52-page booklet, bound for strength and attractive appearance in a white acetate-coated thick paper cover, is available from the British Plastics Federation, 47 Piccadilly, London W.1, or the Surface Coating Synthetic Resin Manufacturers' Association, 79-80 High Holborn, London W.C.1, price 3s. (post free).

* * *

A NEW development for the Epping Auto-Shunter is announced by F. E. Weatherill Ltd., of Union Row, London N.17. A special adaptation of the Muledozer has been introduced which can be quickly fitted to or detached from the Epping Auto-Shunter and which enables the machine to undertake a useful range of bulldozing duties when not engaged on its normal railway wagon shunting tasks. The special weight distribution

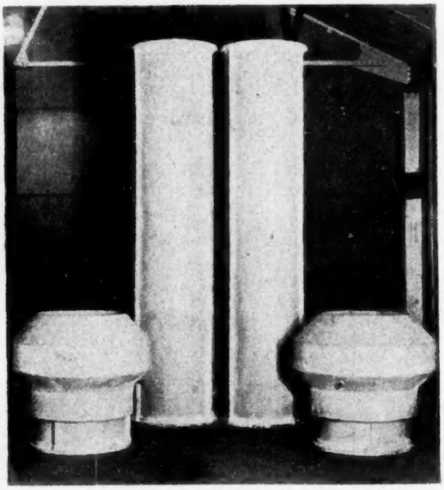


arrangement of the Auto-Shunter which helps to provide the tractive effort for shunting goods of up to 175 tons is also an advantage when the machine is used for bulldozing duties. F. E. Weatherill, distributors of the Epping Auto-Shunter are now undertaking manufacture of the new machine.

TWO sales leaflets (Nos. 9 and 10) issued by Laporte Chemicals Ltd., Luton, describe the properties, uses, storage requirements, etc., of *tert.*-butyl perbenzoate and ammonium, potassium and sodium persulphates.

* * *

APPEARING soon after the announcement of the Transport Commission's development plan for British Railways is a brochure, *I.C.I. Products for Railways,* which contains brief descriptions of the firm's various products used in the industry. Their range is indicated by the subject headings—motive power (steam, electric and diesel), rolling stock (structural, equipment and decoration) and operating and miscellaneous items which range from water-treatment chemicals to surface-active agents used in cleaning formulations and include such items as 'Drikold' refrigerant, metal heat-treatment processes and fog signals. No detailed descriptions or working instructions are given, but there is a list of relevant technical literature.



Because of their high strength/weight ratio and resistance to corrosion, glass reinforced plastics are being increasingly applied in many branches of industry. The photograph shows two Robertson type ventilators to be used in conjunction with the two fume stacks alongside. The stacks, which are about 15 ft. long, and the ventilators were made by James Mitchell & Son (Greenock) Ltd., using Cellobond polyester resins (manufactured by British Resin Products Ltd.) reinforced with glass fibre

FROM acenaphthylene to zincon, additions made by L. Light & Co. Ltd., Poyle, Colnbrook, Bucks, to their 1954 catalogue total 339. Since the company will not be publishing a new complete catalogue for some months yet, they issued an interim list of these additions.

* * *

A NEW high-speed laboratory mill is being produced which, it is claimed, will completely revolutionise existing small batch production and laboratory milling. The manufacturers state that after completing a series of over 400 laboratory tests on a wide range of materials, it has been proved conclusively that the new mill will grind and disperse materials in at least one-tenth of the time normally taken by an orthodox ball or pebble mill. It will also mill to semi-paste consistency, grind materials wet or dry and if necessary process four different substances simultaneously. Formulations processed in this new mill can be reproduced in bulk production with identical characteristics; the time factor is the only variable. The mill has a wide range of applications in various branches of industry, and is particularly suited to the paint industry and paint manufacturers' laboratory. For example, it will grind and disperse a concentrated charge of colour pigment and medium in about 4 hours, a process which normally takes at least 40 hours in an orthodox ball or pebble mill. Alternatively, it will produce a much superior dispersion in 5, 6 or 7 hours' milling time. The new mill is known as the Steel-Shaw High Speed Laboratory Mill (Mark I) and is manufactured by Steele & Cowlishaw Ltd., Hanley, Staffordshire.

* * *

THE new index to silicone publications, produced by Midland Silicones Ltd., replaces the previous list published in June, 1954, and contains a large number of references not included in that issue. The index is divided into sections, according to the different applications of the silicones, and each section is in two parts—Silicone Notes and other publications. The Silicone Notes, all available on request, are publications issued by the firm, describing each silicone product and its uses. The other publications are articles which have appeared in technical journals and which either have permanent value or give the latest information available in printed form. In many cases these can also be obtained.

British Chemical Prices

(These prices are checked with the manufacturers, but it must be pointed out that in many cases there are variations according to quantity, quality, place of delivery, etc.)

LONDON.—Active trading conditions have been reported for most sections of the chemicals market with a steady movement of supplies to the home consuming industries. Inquiry for shipment has also continued on a good scale. The price position remains firm and there has been little change in quotations for any of the routine items including the non-ferrous metal compounds, which are keeping steady on the more settled state of metal prices. No changes of importance have been reported in the coal tar products market. There is a good outlet for most items with values well held.

MANCHESTER.—There has been little change in the general price position of heavy chemicals on the Manchester market, though a feature has been a further advance in quotations for sulphate of copper. The Lancashire textile & allied trades are taking up fair quantities of chemicals under contracts and there is a continued steady call for supplies from other industrial outlets, with caustic soda and most of the other alkalis, especially, moving into consumption in good quantities. A fair movement of supplies of most of the fertiliser materials is reported. There has been little change in conditions in the market for the tar products, most of which, both light and heavy, are going steadily into consumption.

GLASGOW.—Industrial chemicals during the past week have been in steady demand, with little or no change to be reported in general chemical prices. Metals, however, are showing an upward tendency, which is having an effect on their derivatives. The export market is still very satisfactory.

General Chemicals

Acetic Acid.—Per ton : 80% technical, 10 tons, £83 ; 80% pure, 10 tons, £89 ; commercial glacial, 10 tons, £91 ; delivered buyers' premises in returnable barrels (technical acid barrels free) ; in glass carboys, £7 ; demijohns, £11 extra.

Acetic Anhydride.—Ton lots d/d, £123 per ton.

Alum.—Ground, about £23 per ton, f.o.r. MANCHESTER : Ground, £25.

Aluminium Sulphate.—Ex works, £14 15s. per ton d/d. MANCHESTER : £14 10s. to £17 15s.

Ammonia, Anhydrous.—1s. 9d. to 2s. 3d. per lb.

Ammonium Bicarbonate.—2-cwt. non-returnable drums : 1-ton lots, £49 per ton.

Ammonium Chloride.—Per ton lot, in non-returnable packaging, £27 17s. 6d.

Ammonium Nitrate.—D/d, £31 per ton (in 4-ton lots).

Ammonium Persulphate. — MANCHESTER : £6 5s. per cwt. d/d.

Ammonium Phosphate.—Mono- and di-, ton lots, d/d, £97 and £94 10s. per ton.

Antimony Sulphide.—Crimson, 4s. 4d. to 4s. 9½d. ; golden, 2s. 7½d. to 4s. 0¾d. ; all per lb., delivered UK in minimum 1-ton lots.

Arsenic.—Per ton, £45 to £50 ex store.

Barium Carbonate.—Precip., d/d : 4-ton lots, £39 per ton ; 2-ton lots, £39 10s. per ton, bag packing.

Barium Chloride.—£42 15s. per ton in 2-ton lots.

Barium Sulphate (Dry Blanc Fixe).—Precip., 4-ton lots, £42 10s. per ton d/d ; 2-ton lots, £43 per ton d/d.

Bleaching Powder.—£27 17s. 6d. per ton in returnable casks, carriage paid station, in 4-ton lots.

Borax.—Per ton for ton lots, in hessian sacks, carriage paid : Technical, anhydrous, £60 ; granular, £40 ; crystal, £42 10s. ; powder, £43 10s. ; extra fine powder, £44 10s. ; BP, granular, £49 ; crystal, £51 10s. ; powder, £52 10s. ; extra fine powder, £53 10s.

Boric Acid.—Per ton for ton lots, in hessian sacks, carriage paid : Technical, granular, £68 10s. ; crystal, £76 10s. ; powder, £74 ; extra fine powder, £76 ; BP granular, £81 10s. ; crystal, £88 10s. ; powder, £86 ; extra fine powder, £88.

Calcium Chloride.—Per ton lot, in non-returnable packaging : solid, £15 ; flake, £16.

Chlorine, Liquid.—£36 7s. 6d. per ton, in returnable 16-17-cwt. drums, delivered address in 3-drum lots.

Chromic Acid.—2s. 0⅝d. per lb., less 2½%, d/d UK, in 1-ton lots.

Chromium Sulphate, Basic.—Crystals, 7½d. per lb. delivered (£70 per ton).

Citric Acid.—1-cwt. lots, £10 5s. cwt. ; 5-cwt. lots, £10 cwt.

Cobalt Oxide.—Black, delivered, bulk quantities, 13s. 2d. per lb.

Copper Carbonate.—2s. 6d. per lb.

Copper Sulphate.—£101 per ton f.o.b., less 2% in 2-cwt. bags.

Cream of Tartar.—100%, per cwt., about £10 12s.

Formaldehyde.—£37 5s. per ton in casks, d/d.

Formic Acid.—85%, £86 10s. in 4-ton lots, carriage paid.

Glycerine.—Chemically pure, double distilled 1.260 S.G., £13 3s. 6d. to £13 14s. 6d. per cwt. Refined pale straw industrial, 5s. per cwt. less than chemically pure.

Hydrochloric Acid.—Spot, about 12s. per carboy d/d, according to purity, strength and locality.

Hydrofluoric Acid.—59/60%, about 1s. 3d. to 1s. 6d. per lb.

Hydrogen Peroxide.—27.5% wt. £124 10s. per ton. 35% wt. £153 per ton d/d. Carboys extra and returnable.

Iodine.—Resublimed B.P., 17s. 7d. per lb., in 28-lb. lots.

Iodoform.—£1 6s. 7d. per lb., in 28-lb. lots.

Lactic Acid.—Pale tech., 44 per cent by weight £122 per ton ; dark tech., 44 per cent by weight £73 per ton ex-works ; dark chemical quality, 44 per cent by weight, £109 per ton, ex-works ; 1-ton lots, usual container terms.

Lead Acetate.—White : About £147 to £149 per ton.

Lead Nitrate.—About £128, 1-ton lots.

Lead, Red.—Basis prices per ton. Genuine dry red lead, £132 5s. ; orange lead, £144 5s. Ground in oil : red, £150 ; orange, £162.

Lead, White.—Basis prices : Dry English in 5-cwt. casks, £137 10s. per ton. Ground in oil : English, 1-cwt. lots, 178s. per cwt.

Lime Acetate.—Brown, ton lots, d/d, £40 per ton ; grey, 80-82%, ton lots. d/d, £45 per ton.

Litharge.—£134 5s. per ton, in 5-ton lots.

Magnesite.—Calcined, in bags, ex works, about £28 per ton.

Magnesium Carbonate.—Light, commercial. d/d, 2-ton lots, £84 10s. per ton, under 2 tons, £92 per ton.

Magnesium Chloride.—Solid (ex-wharf), £16 per ton.

Magnesium Oxide.—Light, commercial, d/d, under 1-ton lots, £245 per ton.

Magnesium Sulphate.—Crystals, £15 per ton.

Mercuric Chloride.—Technical Powder, £1 8s. 9d. per lb., in 5-cwt. lots ; smaller quantities dearer.

Mercury Sulphide, Red.—£1 11s. 3d. per lb., for 5-cwt. lots.

Nickel Sulphate.—D/d, buyers U.K. £170 per ton. Nominal.

Nitric Acid.—80 Tw., £35 per ton.

Oxalic Acid.—Home manufacture, minimum 4-ton lots, in 5-cwt. casks, about £131 per ton, carriage paid.

Phosphoric Acid.—Technical (S.G. 1.700) ton lots, carriage paid, £92 per ton ; B.P. (S.G. 1.750), ton lots, carriage paid, 1s. 3½d. per lb.

Potash, Caustic.—Solid, £93 10s. per ton for 1-ton lots ; Liquid, £36 5s.

Potassium Carbonate. — Calcined, 96/98%, about £63 per ton for 1-ton lots, ex-store.

Potassium Chloride.—Industrial, 96%, 1-ton lots, about £24 per ton.

Potassium Dichromate.—Crystals and granular, 11⅞d. per lb., in 1-ton lots, d/d UK.

Potassium Iodide. B.P., 14s. 1d. per lb. in 28-lb. lots ; 13s. 7d. in cwt. lots.

Potassium Nitrate.—In 4-ton lots, in non-returnable packaging, paid address, £63 10s. per ton.

Potassium Permanganate.—B.P., 1-cwt. lots, 1s. 8½d. per lb. ; 3-cwt. lots, 1s. 8d. per lb. ; 5-cwt. lots, 1s 7½d. per lb. ; 1-ton lots, 1s. 7d. per lb. ; 5-ton lots, 1s. 6½d. per lb. ; Tech., 5-cwt. packed in 1-cwt. drums, £8 12s. 6d. per cwt. ; packed in 1 drum, £8 11s. 6d. per cwt. ; 1-ton packed in 5-cwt. drums, £8 7s.

Salammoniac.—Per ton lot, in non-returnable packaging, £45 10s.

Salicylic Acid. — MANCHESTER : Technical 2s. 7½d. per lb. d/d.

Soda Ash.—58% ex-depot or d/d, London station, about £15 5s. 6d. per ton, 1-ton lots.

Soda, Caustic.—Solid 76/77% ; spot, £26 to £28 per ton d/d. (4 ton lots).

Sodium Acetate.—Commercial crystals, £91 per ton d/d.

Sodium Bicarbonate.—Per ton lot, in non-returnable packaging, £15 10s.

Sodium Bisulphite.—Powder, 60/62%, £40 to £42 per ton d/d in 2-ton lots for home trade.

Sodium Carbonate Monohydrate.—Per ton lot, in non-returnable packaging, paid address, £59 5s.

Sodium Chlorate.—About £87 per ton in free 1-cwt. drums, carriage paid station, in 4-ton lots.

Sodium Cyanide.—96-98%, £113 5s. per ton lot in 1-cwt. drums.

Sodium Dichromate.—Crystals, cake and powder, 10d. lb. Net d/d UK, minimum 1-ton lots ; anhydrous, 11½d. lb. Net del. d/d UK, minimum 1-ton lots.

Sodium Fluoride.—Delivered, 1-ton lots and over, £4 15s. per cwt. ; 1-cwt. lots, £5 5s. per cwt.

Sodium Hyposulphite.—Pea crystals £34 a ton ; commercial, 1-ton lots, £30 15s. per ton, carriage paid.

Sodium Iodide.—BP, 17s. 1d. per lb. in 28-lb. lots.

Sodium Metaphosphate (Calgon).—Flaked, loose in metal drums, £127 per ton.

Sodium Metasilicate.—£24 per ton, d/d UK in ton lots, loaned bags.

Sodium Nitrate.—Chilean Industrial, over 98% 6-ton lots, d/d station, £27 10s.

Sodium Nitrite.—£32 per ton (4-ton lots).

Sodium Percarbonate.—12½% available oxygen, £8 2s. 10½d. per cwt. in 1-cwt. drums.

Sodium Phosphate.—Per ton d/d for ton lots : Di-sodium, crystalline, £37 10s., anhydrous, £81 ; tri-sodium, crystalline, £39 10s., anhydrous, £79.

Sodium Silicate.—75-84° Tw. Lancashire and Cheshire, 4-ton lots, d/d station in loaned drums, £10.15s. per ton ; Dorset, Somerset and Devon, £3 17s. 6d. per ton extra ; Scotland and S. Wales, £3 per ton extra. Elsewhere in England, excluding Cornwall, and Wales, £1 12s. 6d. per ton extra.

Sodium Sulphate (Glauber's Salt).—About £8 10s. per ton d/d.

Sodium Sulphate (Salt Cake).—Unground. £6 per ton d/d station in bulk. MANCHESTER : £6 10s. per ton d/d station.

Sodium Sulphide.—Solid, 60/62%, spot, £33 2s. 6d. per ton, d/d, in drums ; broken, £33 2s. 6d. per ton, d/d, in drums.

Sodium Sulphite.—Anhydrous, £59 per ton ; pea crystals, £37 12s. 6d. per ton d/d station in kegs ; commercial, £23 7s. 6d. per ton d/d station in bags.

Sulphur.—Per ton for 4 tons or more, ground, £20 to £22, according to fineness.

Sulphuric Acid.—Net, naked at works, 168° Tw. according to quality, per ton, £10 7s. 6d. to £12 ; 140° Tw., arsenic free, per ton, £8 12s. 6d. ; 140° Tw., arsenious, per ton, £8 4s. 6d.

Tartaric Acid.—Per cwt. : 10 cwt. or more, £12 10s.

Titanium Oxide.—Standard grade comm., with rutile structure, £162 per ton ; standard grade comm., £142 per ton.

Zinc Oxide.—Maximum price per ton for 2-ton lots, d/d, white seal, £107 ; green seal, £105 ; red seal, 2-ton lots, £103 per ton.

Solvents & Plasticisers

Acetone.—Small lots: In 5-gal. cans : 5-gal., £125 10-gal. and upward, £115, cans included. In 40/45 gal. returnable drums, spot : Less than 1 ton, £90 ; 1 to less than 5 tons, £87 ; 5 to less than 10 tons, £86 ; 10 tons and upward, £85. In tank wagons, spot : 1 to less than 5 tons (min. 400 gal.), £85 ; 5 to less than 10 tons (1,500 gal.), £84 ; 10 tons and upward (2,500 gal.), £83 ; contract rebate, £2. All per ton d/d.

Butyl Acetate BSS.—£169 per ton, in 1-ton lots ; £167 per ton, in 10-ton lots.

***n*-Butyl alcohol, BSS.**—10 tons, in drums, £154 per ton d/d.

***sec.*-Butyl Alcohol.**—5 gal. drums £159 ; 40 gal. drums : less than 1 ton £124 per ton ; 1 to 10 tons £123 per ton ; 10 tons and over £122 per ton ; 100 tons and over £120 per ton.

***tert.*-Butyl Alcohol.**—5 gal. drums £195 10s. per ton ; 40/45 gal. drums : less than 1 ton £175 10s. per ton ; 1 to 5 tons £174 10s. per ton ; 5 to 10 tons, £173 10s. ; 10 tons and over £172 10s.

Diacetone Alcohol.—Small lots : 5 gal. drums, £177 per ton ; 10 gal. drums, £167 per ton. In 40/45 gal. drums ; less than 1 ton, £142 per ton ; 1 to 9 tons, £141 per ton ; 10 to 50 tons, £140 per ton ; 50 to 100 tons, £139 per ton ; 100 tons and over, £138 per ton.

Dibutyl Phthalate.—In drums, 10 tons, 2s. per lb. d/d ; 45 gal. drums, 2s. ¾d. per lb. d/d.

Diethyl Phthalate.—In drums, 10 tons, 1s. 10½d. per lb. d/d ; 45 gal. drums, 1s. 11¾d. per lb. d/d.

Dimethyl Phthalate.—In drums, 10 tons, 1s. 7¼d. per lb. d/d ; 45 gal. drums, 1s. 8¾d. per lb. d/d.

Dioctyl Phthalate.—In drums, 10 tons, 2s. 8d. per lb. d/d ; 45 gal. drums, 2s. 9½d. per lb. d/d.

Ether BSS.—In 1 ton lots, 1s. 11d. per lb ; drums extra.

Ethyl Acetate.—10 tons lots, d/d, £133 per ton.

Ethyl Alcohol (PBS 66 o.p.).—Over 300,000 p. gal., 2s. 9d. ; 2,500-10,000 p. gal., 2s. 11½d. per p. gal., d/d in tankers. D/d in 40/45-gal. drums, 1d. p.p.g. extra. Absolute alcohol (75.2 o.p.) 5d. p.p.g. extra.

Methanol.—Pure synthetic, d/d, £43 15s. per ton.

Methylated Spirit.—Industrial 66° o.p. : 500 gal. and over in tankers, 4s. 10d. per gal. d/d ; 100-499 gal. in drums, 5s. 2½d. per gal. d/d. Pyridinised 64 o.p. : 500 gal. and over in tankers, 5s. 0d. per gal. d/d ; 100-499 gal. in drums, 5s. 4½d. per gal. d/d.

Methyl Ethyl Ketone.—10-ton lots, £141 per ton d/d.

Methyl *iso*Butyl Ketone.—10 tons and over £167 per ton.

***iso*Propyl Acetate.**—In drums, 10 tons, £128 per ton d/d ; 45 gal. drums, £133 per ton d/d.

***iso*Propyl Alcohol.**—Small lots : 5 gal. drums, £118 per ton ; 10-gal. drums, £108 per ton ; in 40-45 gal. drums ; less than 1 ton, £83 per ton ; 1 to 9 tons £81 per ton ; 10 to 50 tons, £80 10s. per ton ; 50 tons and over, £80 per ton.

Rubber Chemicals

Carbon Bisulphide.—£61 to £67 per ton, according to quality.

Carbon Black.—8d. to 1s. per lb., according to packing.

Carbon Tetrachloride.—Ton lots, £76 10s. per ton.

India-Rubber Substitutes.—White, 1s. 5¾d. to 1s. 9½d. per lb. ; dark, 1s. 4d. to 1s. 6¾d. per lb. delivered free to customers' works.

Lithopone.—30%, about £54 per ton.

Mineral Black.—£7 10s. to £10 per ton.

Sulphur Chloride.—British, about £50 per ton.

Vegetable Lamp Black.—£64 8s. per ton in 2-ton lots.

Vermilion.—Pale or deep, 15s. 6d. per lb. for 7-lb. lots.

Nitrogen Fertilisers

Ammonium Sulphate.—Per ton, in 6-ton lots, d/d farmers' nearest station : March to June, £18.

Compound Fertilisers.—Per ton in 6 ton lots, d/d farmer's nearest station, I.C.I. Special No. 1. January to June, £25 14s.

'Nitro-Chalk.'—£15 14s. per ton in 6-ton lots, d/d farmer's nearest station.

Sodium Nitrate.—Chilean agricultural for 6-ton lots, d/d nearest station : March to June, £26 10s.

Coal-Tar Products

Benzole.—Per gal., minimum of 200 gals. delivered in bulk, 90's, 5s. ; pure, 5s. 4d.

Carbolic Acid.—Crystals, 1s. 4d. to 1s. 6½d. per lb. Crude, 60's, 8s. MANCHESTER : Crystals, 1s. 4½d. to 1s. 6½d. per lb., d/d crude, 8s. naked, at works.

Creosote.—Home trade, 1s. to 1s. 6d. per gal., according to quality, f.o.r. maker's works. MANCHESTER : 1s. to 1s. 8d. per gal.

Cresylic Acid.—Pale 99/99½%, 5s. 9d. per gal. ; 99.5/100%, 6s. per gal. D/d UK in bulk : Pale A.D.F., from 5s. 8d. per Imperial gallon, f.o.b.

Naphtha.—Solvent, 90/160°, 5s. per gal. for 1000-gal. lots ; heavy, 90/190°, 4s. per gal. for 1000-gal. lots, d/d. Drums extra ; higher prices for smaller lots.

Naphthalene.—Crude, 4-ton lots, in sellers' bags, £16 6s. to £24 2s. per ton nominal, according to m.p. ; hot pressed, £40 per ton in bulk ex-works ; purfied crystals, £58 per ton d/d.

Pitch.—Medium, soft, home trade, £8 10s. per ton f.o.r. suppliers' works ; export trade about £10 10s. per ton f.o.b. suppliers' port.

Pyridine.—90/160°, £1 7s. 6d. to £2 per gal.

Toluole.—Pure, 5s. 7d. ; 90's, 4s. 10d. per gal. d/d. MANCHESTER : Pure, 5s. 7d. per gal. naked.

Xylole.—For 1000-gal. lots, 5s. 10d. to 6s. per gal., according to grade, d/d London area.

Intermediates & Dyes (Prices Nominal)

***m*-Cresol** 98/100%.—4s. 3d. per lb. d/d.

***o*-Cresol** 30/31° C.—1s. 4d. per lb. d/d.

***p*-Cresol** 34/35° C.—4s. 3d. per lb. d/d.

Dichloraniline.—3s. 6d. per lb.

Dinitrobenzene.—88/89°C., 1s. 11d. per lb.

Dinitrotoluene.—S.P. 15° C., 1s. 11½d. per lb. ; S.P. 26° C., 1s. 3d. per lb. S.P. 33°C., 1s. 1½d. per lb. ; S.P. 66/68°C., 1s. 9d. per lb.

***p*-Nitraniline.**—4s. 7d. per lb.

Nitrobenzene.—Spot, 9½d. per lb. in 90-gal. drums, drums extra, 1-ton lots d/d buyers' works.

Nitronaphthalene.—2s. per lb.

***o*-Toluidine.**—1s. 9d. per lb., in 8/10-cwt. drums, drums extra.

***p*-Toluidine.**—5s. 6d. per lb., in casks.

Dimethylaniline.—3s. 1d. per lb., drums extra, carriage paid.

Law & Company News

Commercial Intelligence

The following are taken from the printed reports, but we cannot be responsible for errors that may occur.

Mortgages & Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described herein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages or Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary but such total may have been reduced.)

F. COLLINS LTD., Manchester, chemical & general merchants.—10 February, mortgage, to Martins Bank Ltd. securing all moneys due to or to become due to the bank from Television Services (St. Annes) Ltd.; charged on 65 Park Road, St. Annes-on-Sea, with plant, fixtures, etc. *Nil. 19 December, 1953.

Satisfactions

GRIFFIN & GEORGE LTD. (formerly Griffin & Tatlock Ltd. and John J. Griffin & Sons Ltd.), London W.C., instrument makers.—Satisfactions, 17 February, of mortgages registered 24 February, 1947, and charges registered 14 May, 1947.

Increases in Capital

The following increases in capital have been announced: BAXTER BROTHERS (1920) LTD., from £2,000 to £50,000; INSULATING PRODUCTS LTD., from £10,000 to £50,000; BITULAC LTD., from £10,000 to £100,000.

New Registrations

Battelle Institute Ltd.

Company limited by guarantee, without share capital. (544,696.) The original number of members is 7, each being liable for £25 in the event of winding up. Objects: To carry out research and experimental work of all kinds, etc. The income and property of the Institute, whencesoever derived, shall be applied solely towards the promotion of its objects. The management is vested in a Board, the first members of which are:—Clyde E. Williams, Columbus, Ohio, USA, Bertram D. Thomas, Columbus, Ohio, Gerald Battelle Fenton, Black Lick, Columbus, Ohio, John S. Crout, Edward E. Slowter and David C. Minton, Jr., all research executives. Secretary: B. D. Thomas. Reg. office: 46 Bryanston Street W.1.

Agrosupply (Ireland) Ltd.

Private company. (15,521). Registered in Dublin. Capital £100. To manufacture, import, export and deal in artificial, chemical and other manures and fertilisers, etc. Directors: Joseph F. Maher, Andrew A. Morrissey, and Sigmund Kohn.

Deodor-X Holdings Ltd.

Private company. (545,364). Capital £62,500. Manufacturers of and dealers in chemical, sanitary, hygiene, dairy, veterinary, agricultural and horticultural products and air purifiers of all kinds, and germicides and insecticides, etc. Directors: Robt. A. Chandler, Sir Edwd. B. Monkhouse, C.B.E., and Jas. H. Chandler. Secretary: R. W. Wensley. Reg. Office: 36 New Broad Street, E.C.2.

Hedon Chemicals Ltd.

Private company. (545,230). Capital £100. Factors, merchants, manufacturers, importers and exporters of chemicals and chemical products, etc. Subscribers: J. Gilderdale and Wilfred Forrest. The first directors are to be appointed by the subscribers.

Chalk Lime & Allied Industries' Research Association

(544,972). Company limited by guarantee, without share capital. The original number of members is 50, each being liable for £5 in the event of winding up. The word 'Limited' is omitted from the title by licence of the Board of Trade. The income and property of the association, whencesoever derived, shall be applied solely towards the promotion of its objects. The subscribers are: W. L. Clarke, E. J. Wandless and 14 others. The management is vested in a Council, the first members of which are not named.

Diva Laboratories (Great Britain) Ltd.

Private company. (545,645). Capital £10,000. Objects: To carry on, or provide scientific, technical, financial or other

facilities for carrying on research in the field of pharmaceutical, medical, chemical and cosmetic industries, etc. The subscribers (each with one share) are: Geo. Winter and A. K. H. Dickson. The first directors are to be appointed by the subscribers.

Smith Brothers & Co. (Chemicals) Ltd.

Private company. (545,594). Capital £100. Manufacturers, producers, distillers and importers of and dealers in oils, chemicals, greases, lubricants, petrol, glycol, paraffin, benzole, motor spirits, petroleum, oil fuels, etc. The subscribers (each with one share) are: John E. Morris and David W. Scott. The first directors are to be appointed by the subscribers.

Scientific Management Ltd.

Private company. (545,709). Capital £2,000. Industrial, scientific and chemical consultants, chemists' sundriesmen, chemical engineers, etc. Permanent directors: Geo. M. Dyson (managing director) and Bertha F. Dyson. Reg. office: 58 Baxter Gate, Loughborough.

C. Itoh & Co. Ltd.

Registered in Japan in December, 1954, to import, export and sell foreign and domestic products, weighing and measuring instruments, meters, chemicals, motor vehicles, etc. British address: Capel House, 54/62 New Broad Street, E.C.2, where Eisuke Ono is authorised to accept service of process and notices.

Company News

Courtaulds (Australia) Ltd.

Operations by Courtaulds (Australia) Ltd. for the half-year ended 31 December resulted in a loss, although a profit was made in the last two months. At the company's request the Australian Government has approved a new hearing in May by the Tariff Board of an application for tariff duties.

Revertex Ltd.

A satisfactory year's progress for Revertex Ltd. was reported at the annual general meeting on 17 March. Sales volume and net profit both established new records. The chairman, Mr. H. K. Marsh, stated that this year business continued to grow in volume despite growing competition, but the margin of profit was becoming rather smaller. The proposal to increase the authorised capital to £500,000 (see THE CHEMICAL AGE, 1955, **72,** 602) was approved.

Newton Chambers & Co. Ltd.

Net profit after tax of Newton Chambers & Co. Ltd. for 1954 amounts to £317,738, against £163,290 in the previous year. A final dividend of 9 per cent is recommended, to make a total payment of 15 per cent.

British Industrial Plastics Ltd.

Turnover of British Industrial Plastics Ltd. during the year ended 30 September, 1954, amounted to £4,820,000, of which £1,116,000 was contributed by direct export. These two records says the chairman, Mr. K. M. Chance, may be exceeded during the current financial year, as during the Christmas quarter both turnover and profit were substantially exceeded. Group trading profits reached £875,414 (£544,290 in the previous year) and net profits £265,878 (£104,120). The annual 20 per cent dividend is maintained, but the final payment of 12½ per cent (proposed) is payable on £1,247,087, against £831,392 in the previous year.

Petrochemicals Ltd.

The offer by Shell Chemicals Ltd. to acquire the whole of the issued share capital of Petrochemicals Ltd. has been declared unconditional. The offer has been accepted in respect of the whole of the preference shares and over 98½ per cent of the ordinary shares, and the other proposals have been wholly or substantially approved. For the present there will be no change in the conduct of the business of Petrochemicals Ltd. which will be carried on from the same addresses as before.

Changes of Name

The following changes of name have been announced: VENCOL (GT. BRITAIN) LTD., to UEDC (CHEMICALS) LTD., on 17 January; BIGNELL CHEMICALS LTD., to JOHN BIGNELL LTD., on 21 January; WILLOWS FRANCIS PHARMACEUTICAL PRODUCTS LTD., to WILLOWS FRANCIS LTD., on 21 January; STANFIL LTD., to HUBRON SALES LTD., on 21 January; WM. ASKE & CO. LTD., to W. A. (WATERSIDE) LTD., on 7 February.

Chemical & Allied Stocks & Shares

AFTER showing a strong recovery because of indications that the 4½ per cent bank rate is proving effective in strengthening sterling, stock markets reacted sharply following reports of a coming General Election. There was no heavy selling, but buyers were showing caution because of a tendency to await the Budget and also official news whether the election is to be in the summer or the autumn. Opinions are divided in the City whether the Budget will bring any major tax reductions. In some quarters it is contended that tax cuts are unlikely because they would add to inflation dangers. If, after all, the standard rate of income tax were reduced it would have a big stimulating influence on stock markets because it would mean, in effect, an increase in the net return from interest and dividend payments.

Fluctuating Market

Shares of chemical and allied companies fluctuated sharply with the prevailing trend of markets. Imperial Chemical rallied to 42s. but later came back to 41s., which, however, compares with 40s. 1½d. a month ago. Hopes persist in the market that the dividend total for the year on the larger capital will be 10 per cent, on which basis there is a yield of 4⅞ per cent at the current price of the shares. Monsanto 5s. shares have come back on the month from 32s. 3d. to 28s. 9d. despite the raising of the dividend to 22½ per cent. Fisons have been in demand, and though best levels were not held, rose on balance from 55s. 9d. to 59s. Albright & Wilson 5s. shares were 25s. 9d., compared with 27s. a month ago. General Refractories 10s. shares eased to 30s. 9d. on some disappointment with the unchanged 17½ per cent dividend. Laporte 35s. shares at 16s. were within 9d. of the level a month ago. British Chrome & Chemicals 5s. shares strengthened from 12s. 9d. to 13s. 6d. and elsewhere, British Glues & Chemicals 4s. shares moved higher on balance at 13s. 3d. There was a good deal of activity in Reichhold Chemical 5s. shares which have not kept best levels, but at 17s. compared with 15s. 4½d. a month ago. William Blythe 3s. shares were less active, and have come back from 18s. 6d. to 16s. 6d. Boake Roberts 5s. shares receded from 14s. 4½d. to 13s. 9d. with the general trend in stock markets. Burt Boulton & Haywood at 31s. 3d. lost part of the rise which followed the higher interim dividend. Hickson & Welch 10s. shares were 18s. 6d. Lawes Chemical 10s. shares eased from 15s. to 14s. 6d.

Brotherton 10s. shares have been a good feature with a rise on the month from 28s. 9d. to 30s. 6d. Coalite & Chemical 2s. shares displayed activity, but have not kept best prices and were 4s., compared with 4s. 4½d. a month ago. Greeff-Chemicals Holdings 5s. shares came back from 15s. 7½d. to 14s. 7½d. Plastics shares were more active with British Xylonite 39s. 6d. or within 6d. of the level ruling a month ago, while under the influence of the results. Bakelite 10s. shares moved up from 28s. 9d. to 29s. 9d. British Industrial Plastics 2s. shares reflected the full results and chairman's review, and have moved up from 5s. 4½d. to 6s. Ashe Chemical 1s. shares were quoted at 1s. 6d.

Election Pointer

British Oxygen receded on the month from 64s. 3d. to 63s. but Boots Drug 5s. units at 27s. 3d. were higher on balance helped by talk of a possible increase in the dividend. There was a large business in Borax Consolidated, which did not keep best levels, but were 99s. 9d. compared with 98s. 3d. a month ago. In other directions, Staveley were 57s. xd and Powell Duffryn 10s. shares 17s. 6d. Steel shares have been an active market and were slightly higher on balance with Stewarts & Lloyds at 48s. Success of the Firth-Brown debenture and share offer was a reason. Moreover if the Labour Party were defeated at the next General Election, it is assumed in the City that this would mean that steel would never again be nationalised. It is believed that the question of the next steel share offer, which may be shares in the Steel Company of Wales, is likely to be left until after the Budget or perhaps until after the General Election. Nevertheless it is assumed in the City that meanwhile there may be several offers of preference shares and debentures in steel companies.

Next Week's Events

MONDAY 28 MARCH

Royal Society of Arts

London: John Adam Street, Adelphi, W.C.2, 6 p.m. Third of three Cantor Lectures on 'The Mechanical Properties of Metals': 'Fatigue' by Major P. L. Teed.

Institute of Fuel

Middlesbrough: The Cleveland Institute, 6.30 p.m. 'Producer Gas' by Dr. G. D. Milner.

Institution of the Rubber Industry

Manchester: The Engineers' Club, Albert Square, 6.15 p.m. 'Application of Rubber to Fibres' by Dr. T. S. McRoberts and C. D. Hogg.

TUESDAY 29 MARCH

SCI (Food Group)

Belfast: Department of Geology, Queen's University, 9 a.m. Opening of symposium on bacon, held jointly with Northern Ireland Section (until 31 March).

WEDNESDAY 30 MARCH

Royal Institute of Chemistry

London: Chelsea Polytechnic, Manresa Road, S.W.3, 7 p.m. 'Man-made Textile Fibres' by F. V. Davis (joint meeting with Chelsea Polytechnic Chemical Society).

Chemical Society

London: Royal Institution, Albemarle Street, W.1, 10.30 a.m. Symposium on Peptide Chemistry (anniversary meeting).

SCI (Corrosion Group)

London: Convocation Hall of Church House, S.W.1, 6.30 p.m. Spring lecture: 'Attention to Corrosion in the USA' by F. L. LaQue.

Manchester Literary & Philosophical Society (Chemical Section)

Manchester: Portico Library, 57 Mosley Street, 6 p.m. 'Inspiration and/or Plodding in Chemical Research.'

British Ceramic Society

Durham: Three Tuns Hotel, 11 a.m. Opening of Building Materials Section meeting (also on 31 March).

Society of Instrument Technology

Middlesbrough: Cleveland Scientific and Technical Institution, Corporation Road, 7.30 p.m. 'Automatic Control for Dial Weighing Machines' by R. A. Lolley (I.C.I.).

THURSDAY 31 MARCH

Chemical Society

London: Royal Institution, Albemarle Street, W.1, 11 a.m. 'The Outlook for Industrial Atomic Energy in Europe' by Dr. G. Randers (anniversary meeting).

SCI (Corrosion Group)

London: The Institution of Civil Engineers, Great George Street, S.W.1, 9.30 a.m. Symposium on 'The Protection of Structural Steel' (also on 1 April).

FRIDAY 1 APRIL

SCI (Pesticides Group)

Manchester: The Engineers' Club, Albert Square, 6.30 p.m. 'Proofing of Fabrics from Insect and Fungus Attack' by Dr. R. G. Fargher (preceded by AGM of Manchester Section).

Institute of Fuel

Cardiff: South Wales Institute of Engineers, Park Place, 6 p.m. 'Start of the National Industrial Fuel Efficiency Service' by Dr. W. A. Macfarlane.

Lectures at Norwood

BEGINNING on 23 April, a course of 12 lectures and appropriate practical work on micro and semi-micro techniques in chemistry will be held at Norwood Technical College, Knight's Hill, London S.E.27, on Saturday mornings from 9.15 a.m. to 12.30 p.m. Lectures, illustrated by demonstrations, will deal with organic preparative techniques, qualitative analysis and physicochemical methods of analysis, the design and construction of apparatus, and simple chemical microscopy.

In the main, apparatus either easily constructed or normally at hand will be used, as the course is of an essentially practical nature. The fee for the course is £1 2s. 6d., and application for admission should be made to the Secretary of the College.

Oil Found in Assam

New sources of petroleum have recently been discovered by the Assam Oil Company in the Naharkatiya area in Assam. The extent and importance of the discovery of the field have not yet been established.

CLASSIFIED ADVERTISEMENTS

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive, or a woman aged 18-59 inclusive, unless he or she, or the employment, is excepted from the provisions of the Notifications of Vacancies Order, 1952.

APPLICATIONS are invited from **CHEMISTS** for a progressive position in a large industrial Research Laboratory, to study problems connected with the formulation and testing of detergent blends. Applicants should have a good degree or equivalent experience, preferably in the detergent and textile fields. Good salary commensurate with qualifications and experience. Apply **MANAGER, SALES SERVICE LABORATORY, LAPORTE CHEMICALS LIMITED, LUTON, BEDS**

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The minimum qualification is Higher School Certificate in Science subjects, but pass degrees, in Chemical Engineering for Post 1, and in Physics for Post 2, is desirable.

SALARY.—£1,090-£1,285 (male) (minimum age, normally 35).

SUPERANNUATION.—Successful applicants will be required to join the Authority's Contributory Scheme.

HOUSING.—Housing accommodation will be available within a reasonable period for married staff who live outside the radius of the Establishment's transport facilities. During this period lodging allowance may be payable.

Send postcard for application form to Senior Recruitment Officer, A.W.R.E., Aldermaston, Berks. Quote appropriate reference.

SITUATIONS VACANT

CHEMIST OR CHEMICAL ENGINEER (Graduate), age not over 35, with experience in the manufacture of synthetic adhesives, required to design and operate a plant for the manufacture of urea-formaldehyde and P.V.A. emulsions. Salary will depend on age, qualifications and experience. Candidates should apply, stating salary required, to **BOX 3031, ROBERTSON & SCOTT 42, CHARLOTTE SQUARE, EDINBURGH 2.**

CHEMIST—WORKS MANAGER (young) required for small, busy, old-established firm making wide range of sanitary, cleansing and floor maintenance products. Situated near London Bridge. Must be interested in development of new lines. Commencing salary, £500-£600. State age, experience, etc. **BOX No. C.A. 3395, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

THE UNITED KINGDON ATOMIC ENERGY AUTHORITY, ALDERMASTON, BERKS, requires a **PRINCIPAL SCIENTIFIC OFFICER** or **SENIOR SCIENTIFIC OFFICER,** to lead a team concerned with developing special equipment from fundamental studies of a physico chemical nature, including hydrodynamical and fluid pumping problems, electro chemistry of solutions, chemical kinetics and phase equilibria. Applicants should have a First- or Second-Class Honours Degree in Chemical Engineering with experience of research in that field, or in Chemistry with post-graduate experience either as a physical chemist in the chemical engineering field, or as a research chemical engineer. Ability to assess the economic aspects of process development is also necessary.

Salary : Principal Scientific Officer, £1,205-£1,615 per annum (male), or Senior Scientific Officer, £1,040-£1,205 per annum (male). The successful applicant will be required to join the Authority's contributory superannuation scheme.

Housing accommodation will be available within a reasonable period for married staff who live outside the radius of the Establishment's transport facilities.

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